North American Uredineae

E. W. D. Holway

MINNEAPOLIS, MINNESOTA
1905-1924

UNIVERSITY OF ARIZONA
589.225
q H75
LIBRARY

FOREWORD.

Even a long life is never long enough to complete all the large projects begun by an active and resourceful person. Such a person was Professor E. W. D. Holway, as the writer knows from nearly a half century of co-operation in scientific labors. His varied interests embraced such diverse pursuits as banking, expert accounting, book-collecting, mountain-climbing, artistic and scientific photography, botanical exploration and, as a passionate avocation, the study of plant-rusts. In none of these lines was he content to become simply efficient, but made himself master of methods and by a habit of critical inspection thereby advanced knowledge.

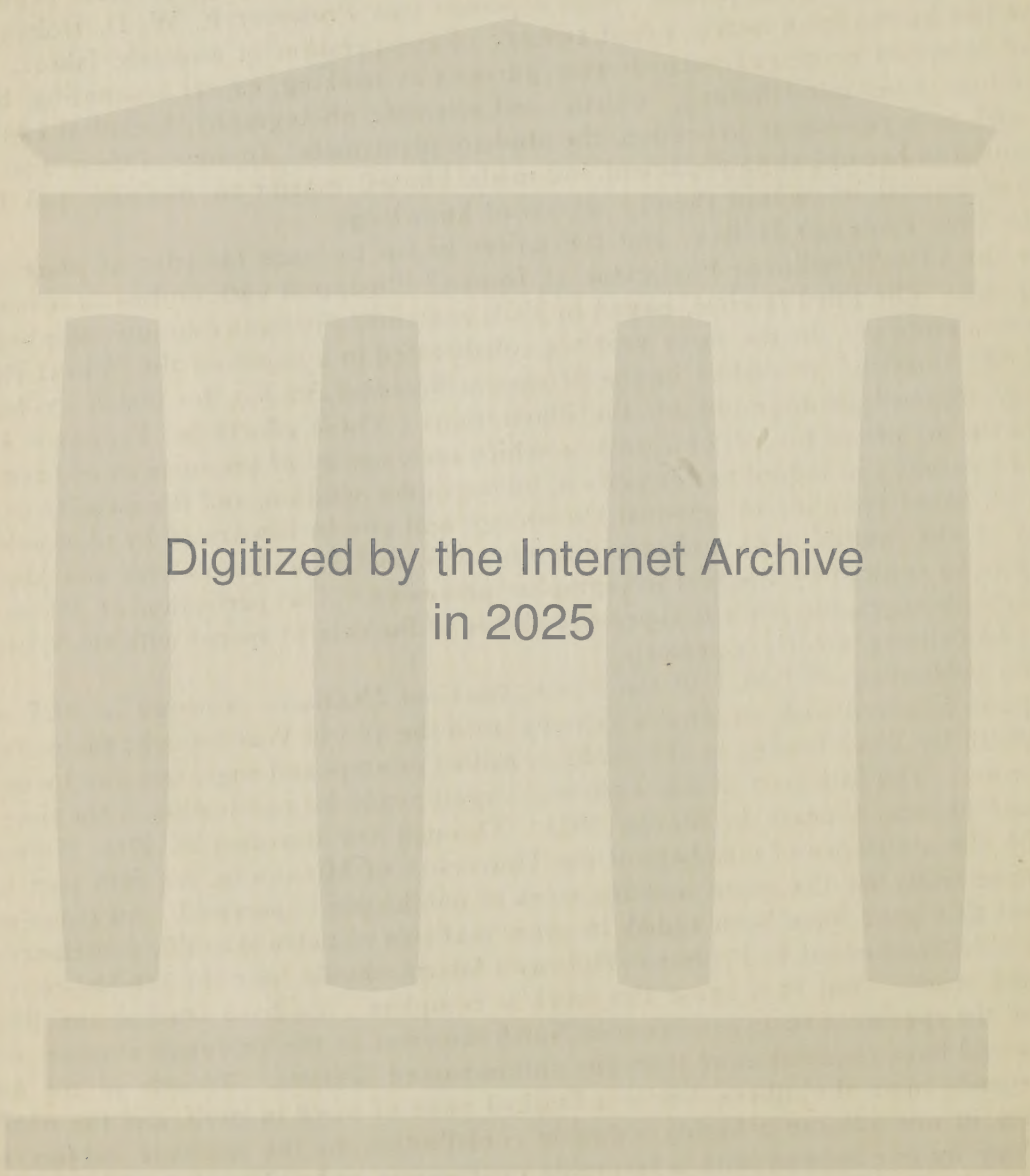
In 1894 Professor Holway and the writer began to issue fascicles of plant-rusts under the title "Uredineae Exsiccatae et Icones," illustrated with outline drawings of the spores. The third fascicle, issued in 1901, contained photomicrographs supplied by Professor Holway. In the same year we collaborated in a paper on the "Violet Rusts of North America," published in the *Minnesota Botanical Studies,* for which Professor Holway supplied photographs for the illustrations. These efforts led Professor Holway to the ambitious project of a work in which each species of the rusts should receive critical treatment in regard to description, bibliographic citation, and the identity of the hosts, all based upon direct personal knowledge, and also be illustrated by photomicrographs of the spores, with uniform magnification, and reproduced with the utmost fidelity to be secured by the best lithographic processes. The perfection of Professor Holway's photographic work is especially shown in the case of spores with thick, dense walls and delicate, colorless pedicels.

The publication of Part I of the *North American Uredineae* occurred in 1905, and other parts followed with reasonable rapidity until the World War brought the work to a standstill by disturbances in the ranks of skilled printers and engravers and by exorbitant costs. The fifth part of the work was largely ready for publication at the time of Professor Holway's death in March, 1923. Through the devotion of Mrs. Holway, and with the assistance of members of the University of Minnesota, the fifth part has been made ready for the press, and the work of publication supervised. An index and a general title page have been added, in order that this valuable scientific contribution, and the chief monument to Professor Holway's labors, should bear the semblance to a completed work. And in a sense the work is complete. To have studied and illustrated all the species of rusts occurring in North America in the thorough manner projected would have required more than one uninterrupted lifetime. No one of the five parts depends upon the others, but is a finished piece of work in itself, and the whole represents in one volume a highly valuable contribution to the intricate subject of uredinology by one imbued with a favorable predilection and unbounded zeal.

JOSEPH CHARLES ARTHUR

Purdue University, Lafayette, Indiana
December 10, 1923

82321



Digitized by the Internet Archive
in 2025

https://archive.org/details/northamericanure0000ewdh

Complete in one volume, but published as Vol. I, Parts 1-5, as follows:
Pages 1-32, issued April 15, 1905.
Pages 33-56, issued May 15, 1906.
Pages 57-80, issued May 10, 1907.
Pages 81-96, issued June 11, 1913.
Pages 97-131, issued July 2, 1924.

ERRATA.

Text corrected

Page 65, at end of the first line of the synonyms, *for* 1873, *read* 1875.

Page 70, from the exsiccati omit "Carleton Ured. Am. *28*."

Page 87, from the exsiccati, after Ellis & Everh. N.Am. Fungi, omit "1459."

North American Uredineae

E. W. D. Holway

Vol. I. Part 1.

Genus Puccinia.

Ranunculaceae. Berberidaceae. Papaveraceae. Bromeliaceae. Commelinaceae.
Juncaceae. Liliaceae. Amaryllidaceae. Iridaceae.
Orchidaceae.

Minneapolis, Minnesota
Issued April 15, 1905

PREFACE.

The rapid increase in the number of species of Uredineae makes it impossible for many collectors to obtain the specimens for comparison, and the design of this work is to furnish such descriptions and photomicrographs as will enable anyone to determine the most of them.

The descriptions are all drawn from the specimens and the references to exsiccatae and the localities cited are from specimens in the herbarium of the University of Minnesota, as it has seemed best to make this work a record of actual observations and not a compilation. Special attention will be paid to the correction of errors in the naming of the host plants, but as many specimens consist of a single leaf, or fragment of a leaf, distorted, frequently, by the fungus, some undoubtedly will not be noticed.

Many differences from other works will be noted in the references to volume, page and year, but I have verified all except those prefixed with a *, and they can be relied upon. In cases of reprints where it seemed probable that the paging was different from the original, the page is given thus: —(19).

The photographs are all magnified 250 diameters unless otherwise stated.

Minneapolis, Minn., Mar. 1, 1905.

NORTH AMERICAN UREDINEAE.

Pucciniae species disponere difficilimum est; vera crux mycetologonum.—*Bagnis. Le Puccinie.*

PUCCINIA Pers.

Roemer Neues Mag. 1:118. 1794.

Parasitic fungi, occurring on living plants, principally on the leaves, but often on all parts, even attacking underground portions. Spore-forms; Spermatia (O), Aecidiospores (I), Uredospores (II), Amphispores (X), Teleutospores (III). The spermogonia in which the spermatia are produced are very small subglobose, pyriform, or flask-shaped bodies, in some species sunk in the epidermis, in others just covered by the cuticle, through which the neck protrudes. The spermatia are hyaline and minute.

The aecidiospores are formed in aecidia developed in the subepidermal parenchyma of the host, and are subglobose cup or flask-shaped bodies, surrounded in most species by a wall of large thick-walled cells, the pseudoperidium. This may open by a pore, or by breaking irregularly, or by splitting into few or into many segments which become reflexed. The aecidiospores are always one-celled, mostly polygonal from pressure, and are abstricted one after another in basipetal succession from the closely packed hyphae. They have several germ-pores, a hyaline epispore, and mostly yellow or orange contents.

The uredospores are formed in uredosori just beneath the epidermis which is ruptured by the growing spores that soon become exposed and pulverulent. They are produced singly on the terminal ends of the hyphae, are always one-celled, globose, ovate, elliptical, or pyriform, more or less tuberculate or echinulate, never smooth, with two to twelve germ-pores, rarely with one, and varying in color from light yellow to dark brown.

The amphispores are one-celled thick-walled spores, only known in a few species, which germinate in the manner of the uredospores, but which, like most teleutospores, do so only after a dormant period and exposure to extremes of weather.

The teleutospores are formed in teleutosori, originating in the same way as the uredosori, but they are mostly dark brown to black, and often firm instead of pulverulent. They have separate pedicels, which are sometimes persistent and

sometimes fragile, and typically the spores are two-celled, but one-celled spores are of frequent occurrence, and three and four-celled spores and various irregular and monstrous forms are not uncommon. In each cell there is one germ-pore, rarely two in the lower cell and two or three in the upper. The germinating teleutospores send out a cylindrical promycelial tube, which becomes four-celled at the apex, and from each cell there arises a short, pointed branch producing one sporidium. These sporidia germinate, producing short, acute pointed tubes, which penetrate the tissues of the proper host-plant. In germinating, the uredospores, amphispores and aecidiospores send out simple vegetative germ-tubes.

While the spermatia can be made to germinate in nutrient solutions, they appear to have become entirely functionless, and it is probable that they are male cells which formerly took part in a process of fertilization in connection with the aecidium.

RANUNCULACEAE.

CALTHA.

1. Puccinia Calthae Link.

Linn. Sp. Plant. 6^2:79. 1825.

Syn: Aecidium Calthae Grev.? Fl. Edin. :446. 1824.
Puccinia elongata Schroet. Cohn Beitr. 3:61. 1879.

Sori amphigenous, punctiform to ¾ mm. diameter, scattered, or often thickly covering the leaf, at first covered by the epidermis, at length pulverulent.

II. Uredosori chestnut brown; uredospores globose, ovate, or elliptical, light brown, echinulate, 24—32×20—24μ; germ-pores 2–3.

III. Teleutosori dark brown; teleutospores smooth, somewhat variable in shape and size, oblong, angular, or elliptical, rarely clavate, apex with a pale, conical papilla, often with a similar one over the germ-pore of the lower cell, 28—44×16—24μ; pedicel hyaline, persistent, up to 80μ long.

On Caltha palustris L. Canada, Iowa.

Exsic: Ellis & Everh. N. A. F. 2415.
Photo: No. 1. From Decorah, Ia.

No specimens of the aecidium have been seen. Those in Thuemen, Mycoth. univ. 1716, are Puccinia calthaecola Schroet., my specimen having all three stages on the same leaf. Plowright describes an aecidium for Puccinia Calthae and no other Puccinia has been found in England on Caltha. Dr. Winter describes the aecidia for both species (Hedw. XIX:107. 1880), and says that the aecidium of Puccinia Calthae has the pseudoperidium much incised, while in Puccinia calthaecola it is split into 4-5 divisions, but in his "Pilze," published later, he men-

tions no difference. It has sometimes been doubted whether Puccinia Calthae has an aecidium, but Dr. Winter, Hedw. l. c. :106, says: "Von den beiden Caltha bewohnenden Puccinien habe ich dieses Frühjahr die Aecidien gefunden. Puccinia Calthae war im vorrigen Herbst auf einigen Caltha-Stöcken am Rigi häufig, die ich genau markirte; auf dieselben Pflanzen fand ich vor 14 Tagen das Aecidium, das also Zweifellos zu dieser Puccinien gehört. Von Puccinia calthaecola habe ich vor wenigen Tagen alle drei Fruchtformen gleichzeitig auf demselben Blatte aufgefunden."

2. Puccinia calthaecola Schroet.

Cohn Beitr. III:61. 1879.

Syn: Puccinia Zophii Wint. Hedw. 19:39 et 107. 1880.

O. Spermogonia few, clustered in the center of the groups of aecidia.

I. Aecidia hypophyllous, on yellow spots, closely clustered, 12–100 aecidia in a group, margins recurved and split into 4–5 segments; aecidiospores orange, globose to elliptical, minutely tuberculate, 20—28×16—24μ.

II. III. Sori amphigenous, punctiform, soon naked, pulverulent, scattered.

II. Uredosori chestnut brown; uredospores light brown, globose to ovate, echinulate, 24—32×24—28μ; germ-pores 2–3.

III. Teleutosori dark brown; teleutospores dark brown, elliptical to oblong, sometimes irregular, mostly rounded at both ends, apex with a slight papilla, faintly tuberculate, 40—52×26—36μ; pedicel hyaline, about the length of the spore, fragile.

On Caltha palustris L. Mich., Ia., Minn.

Photo: No. 2. From Decorah, Ia.

The only specimen of aecidium from N. Am. that I know of was collected at Decorah, Iowa, in May.

3. Puccinia gemella Diet. & Holw.

Syd. Monogr. Ured. 1:541. 1903.

III. Spots none or pale yellow. Teleutosori amphigenous, punctiform to 2mm. in diameter, sometimes confluent, dark brown, pulverulent. Teleutospores brown, smooth, oblong-fusiform, apex with a large conical pale papilla, and often with one over the germ-pore of the lower cell, not constricted, 40—60×20—28μ; pedicel hyaline, up to 60μ long, fragile.

On Caltha leptosepala DC., Wash. Caltha Howellii Greene. Calif.

Exsic: Sydow Ured. 1769.
Photo: No. 3. From the type specimen on Caltha leptosepela, Mt. Ranier, Wash.

This species probably has uredospores, as a few have been found intermixed with the teleutospores, which were pale brown, globose to elliptical, shortly echinulate, 24—32×20—24μ, with six germ-pores.

4. Puccinia areolata Diet. & Holw.

Bot. Gaz.: 19:304. 1894.

I. Aecidia hypophyllous, on yellow spots, in small irregular groups, pseudoperidia, white (when dry), reflexed, split into 4–6 segments; aecidiospores ovoid, minutely verrucose, 24—29×20—24μ.

II. III. Sori hypophyllous, punctiform to 1mm. in diameter, scattered, or in small clusters, sometimes circinnate.

II. Uredosori brown; uredospores light brown, echinulate, spines rather distant, 24—32×22—24μ; germ-pores 2.

III. Teleutosori dark brown; teleutospores dark brown, minutely verrucose, quite variable in shape and size, mostly oblong or clavate, more rarely elliptical, apex with a large hyaline papilla and a similar one over the germ-pore of the lower cell, rounded or somewhat narrowed towards the base, constricted at the septum, 46—72×21—34μ; pedicel about the length of the spore, hyaline, very fragile.

On Caltha biflora DC., Wash.

Photo: No. 4. Type specimen.

The specimens distributed by Nelson under this name in Pl. of Wyo. 7931, are Puccinia Treleasiana. Only a few uredospores have been seen which all had two germ-pores.

5. Puccinia Treleasiana Pazschke.

Rabh. Fg. eur. 3821: O. 1892. Hedw. 31:317. D. 1892.

III. Teleutosori amphigenous, mostly hypophyllous, often elongated on the petioles, round to oblong on the leaves, 1-2mm. in diameter, often confluent and covering considerable portions of the leaf, dark brown, pulverulent. Teleutospores elliptical to ovoid, rarely oblong, mostly with both ends rounded, apex with a small pale papilla, slightly verrucose, brown, 32—48 ×22—24μ, mostly 40×24μ; pedicel hyaline, slender, very fragile, up to 80μ long.

On Caltha leptosepala DC., Col., Utah. Caltha rotundifolia (Huth.) Greene. Wyo. Caltha chionophila Greene. Col.

Exsic: Baker Pl. W. Cen. Col. 490. Roum. Fg. Gall. 3921. Rabh. Fg. eur. 3821. E. & E. Fg. Columb. 1868. N. A. F. 3244. Garrett Fg. Utah, 23. Nelson Pls. Wyo. (labeled Puc. areolata), 7931.

Photo: No. 5. On Caltha leptosepala, type collection, Col.

DELPHINIUM.

6. Puccinia Delphinii Diet. & Holw.

Hedw. 32:29. 1893.

III. Teleutosori mostly hypophyllous, and on the petioles, small, but confluent into large groups, intermixed with the ruptured epidermis, pulverulent, dark brown; teleutospores elliptical, brown, minutely verrucose, rounded at both ends, wall thin, 24—32×16—24μ; pedicel hyaline, fragile, short.

On Delphinium sp. King's River Canon, Calif.

Photo: No. 6. Type specimen.

ANEMONE.

7. Puccinia cohaesa Long.

Bull. Torr. Bot. Club. 29:112. 1902.

O. Spermogonia black, very numerous, often covering the entire underside of the leaf, without being accompanied by the other spore-forms, sometimes associated with the teleutospores; amphigenous when with the aecidia.

I. Aecidia hypophyllous, evenly covering the leaves or somewhat scattered, margin reflexed, divided into 3–5 lobes; aecidiospores yellow, angular, minutely verrucose, 16—22μ in diameter.

II. Uredosori hypophyllous, cinnamon-brown, ½-1mm. in diameter, for sometime covered by the epidermis, at length pulverulent; uredospores pale yellowish-brown, elliptical, ovate, or oblong, echinulate, spines short, apex up to 6μ thick, 26—36×16—22μ; germ-pores 4, equatorial; paraphyses capitate, yellowish, up to 70μ long, abundant at the margin of the sori, and sparingly intermixed.

III. Teleutosori mostly hypophyllous, scattered or circinnate, minute to 1mm. in diameter, at first covered by the epidermis, which remains surrounding the mature sori. Teleutospores elliptical, mostly rounded at both ends, verrucose, tubercles large and blunt, constricted at the septum, chestnut brown, 28—40×18—24μ, rarely 48μ long; pedicels hyaline, mostly short, sometimes the length of the spore, fragile.

On Anemone caroliniana Walt. Austin, Texas.

Exsic: Ellis and Everh. Fg. Columb. 1643.
Photo: No. 7. Type collection.

The aecidium cannot be distinguished from the common Aecidium punctatum Pers., and possibly has no connection with this species. A large amount of material has been examined, however, and the way in which the different stages are associated does not seem to be accidental.

8. Puccinia fusca (Pers.) Wint.

Rabh. Krypt. Fl. 1:199. 1884.

Syn: Aecidium fuscum Pers. Linn. Syst. Nat. 2^2:1473. 1791. et Relhan Fl. Cantab. Supp. III:36. 1793.
Puccinia Anemones Pers. Obs. II:24. 1799.

O. Spermogonia dark brown at first, becoming nearly black, conical, about 120μ wide, and 80μ high, often on both sides of the leaf, occasionally only hypophyllous.

III. Teleutosori nearly all hypophyllous, brown, at first covered by the epidermis, early naked, pulvinate, pulverulent. ½-1mm. in diameter, sometimes confluent. Teleutospores chestnut-brown, of two nearly equal cells, which are mostly globose, sometimes elliptical, oblong, or angular, strongly constricted so that the cells easily separate, closely and evenly verrucose, 28—44×16—24μ; pedicel hyaline, fragile, mostly short, occasionally up to the length of the spore.

On Anemone quinquefolia L. Canada, Ia., Mich., Ohio, Wisc., N. Y., Mass. Probably found wherever the host occurs. It has no aecidial stage.

Exsic: Ellis & Everh. N. A. F. 2722. Seym. & Earle. Econ. Fg. 451. Kellerm. Ohio. Fg. 106. Rabh. Fg. eur. 3117.
Photo: No. 8. From Decorah, Ia.

9. Puccinia De Baryana Thuem.

Flora LVIII:364. 1875.

Syn: Puccinia compacta De By. *Rabh. Klotzsch. Herb. Mycol. VII:88. 1858. Bot. Zeit. 16:83. 1858. (Not Puccinia compacta Kze. *Weigel Pl. Sur. 1830.)
Puccinia Pulsatillae Kalchbr. Math. es termeszett Kolemenyek III:307. 1865.
Puccinia Anemones-Virginianae aut.

III. Teleutosori amphigenous, black, subrotund, or elongated up to 7mm. in length, the leaf colored red or purple around the sori which are depressed beneath and more or less pulvinate above, firm, covered by the epidermis; teleutospores smooth, light brown, oblong to clavate, constricted at the septum, lower cell mostly oblong and narrowed to the short, slightly tinted pedicel, upper cell often darker, apex deep brown, 4–8μ thick, rounded, truncate, or variously angled, 40—72×16—22μ; paraphyses numerous, brown. Pedicels are occasionally found up to 20μ long.

On Pulsatilla hirsutissima (Pursh) Britton. Iowa, S. Dak. On Anemone parviflora Michx. Yoho Valley, Canada. Anemone Drummondii, Mt. Hood, Ore.

Ranunculaceae.

Exsic: Ellis N. A. F. 1456. Griffiths West. Am. Fg. 273a. Arth. & Holw. Ured. Exsic. 12b.
Photo: No. 9A. From Anemone Drummondii, Mt. Hood, Ore.
No. 9B. From Pulsatilla hirsutissima. Decorah, Ia.
No. 9C. From Anemone parviflora, Yoho Valley, Canada.

The description is made from the specimens on Pulsatilla hirsutissima. Bubak describes several forms of this rust, and ours is his *forma genuina*. The other specimens which I have placed here were collected at about seven thousand feet elevation, not far from glaciers. On Anemone Drummondii the sori are not in round clusters, but surround the stems for 30mm. in length and evenly cover the involucral leaves on both sides; on Anemone parviflora the sori are in round clusters, mostly on the upper surface, and the spores are thinner-walled and rather longer. They all have numerous brown paraphyses.

10. Puccinia Anemones-Virginianae Schw.

Schrift. nat. Ges. Leipzig : 72. 1822.

Syn: Puccinia solida Schw. Proc. Am. Phil. Soc. 4:296. 1834.
Puccinia simplex Peck. Rep. State Mus. Nat. Hist. N. Y. 34:45. 1881.
Puccinia solitaria Syd. Monogr. Ured. 1:483. 1903.

III. Spots brown or purplish. Sori mostly hypophyllous, scattered, minute to 1mm. in diameter, round, firm, dark brown; teleutospores clavate to linear, germinating in the sorus, constricted, nearly hyaline, except the thickened apex (6–12μ), which is pale brown, mostly with a conical point, but sometimes rounded, truncate or variously angled, 38—60×10—16μ; paraphyses none; pedical persistent, hyaline, mostly short, rarely up to 40μ long.

On Anemone cylindrica Gray. A. Canadensis L. A. Virginiana L. Del., N. Y., Mich., Iowa, Minn., N. Dak., Ills., Mass.

Exsic: Ellis & Everh. N. A. F. 1847. Fg. Columb. 1845. Thuem. Mycoth. univ. 1525. Arth. & Holw. Ured. Exsic. 12a.
Photo: No. 10. From Anemone cylindrica, Decorah, Ia.

I have examined a type specimen of Puccinia simplex Peck, and find that it differs in no way from this species. The host is no doubt some Anemone.

11. Puccinia gigantispora Bubak.

Sitzunsber. Königl. Ges. Wissensch. Prag. :9. Jan. 11, 1901.

I. Aecidia hypophyllous on purple spots, 1–40 aecidia together, orange-red, about 1mm. high, margin reflexed when fully mature, spores orange, finely verrucose, 20—28×16—20μ.

III. Teleutosori amphigenous, at first surrounding the aecidia, later in separate sori, black, at first covered by the epidermis, finally becoming more or less naked; teleutospores smooth, brown, clavate to linear, 48–96μ long, lower cell often twice the length of the upper, linear, narrowed to the

short, tinted pedicel, 6–15μ wide, cells rarely subequal; upper cell often darker, 16–24μ wide, apex deep brown, 4–12μ thick, round, truncate, or pointed; paraphyses not present.

On Anemone globosa Nutt. Mont., Canada.

Photo: No. 11. Specimen from Banff, Canada.

The type specimen was collected at Livingston, Mont., by Prof. Seymour, and distributed as on Pulsatilla hirsutissima, but it is on Anemone globosa. Bubak describes the paraphyses as sparingly developed, but none could be found, although a large number of sections were examined.

12. Puccinia retecta Syd.

Ann. Mycol. 1:34. 1903.

III. Sori amphigenous on yellow spots, minute, closely clustered in round groups, up to 4–5mm. in diameter, surrounded by the ruptured epidermis, pulverulent, cinnamon-brown. Teleutospores elliptical, brown, rounded at both ends, closely verrucose, apex not thickened, but sometimes with a small papilla, not at all or slightly constricted at the septum, 32—40× 20—26μ; pedicel hyaline, fragile, short.

On Anemone narcissiflora L. Col.

Exsic: Griffiths West. Am. Fg. 328.
Photo: No. 12.

PULSATILLA. THALICTRUM.

13. Puccinia Pulsatillae (Opiz) Rostr.

(Not Puccinia Pulsatillae Kalchbr.)

Cat. des pl. que la soc. de bot. de Copenhague peut distrib: 1. 1881.

Syn: Dicaeoma Pulsatillae Opiz. *Boehm. phan. u. krypt. Gewächse: 148. 1823.
Puccinia Thalictri Chev. Fl. Paris 1:417. 1826.
Puccinia suffusca Holw. Jour. Mycol. 8:171. 1902.

III. Sori hypophyllous, dark brown, punctiform to 1mm. in diameter, at first covered by the epidermis, which remains surrounding the sori, never confluent, quite evenly scattered over the leaf, pulverulent. Teleutospores chestnut-brown, rarely of two globose cells, the lower often much longer and narrowed to the pedicel, both cells sometimes angular or oblong, strongly constricted at the septum, and easily separating, verrucose, the tubercles larger and not so regular as in Puccinia fusca, varying greatly in size, 28—40×16—28μ; pedicel hyaline, generally about one-third the

length of the spore. One-celled teleutospores are numerous. The lower cell is sometimes lighter colored than the upper.

On Pulsatilla hirsutissima (Pursh)Britton. Ia., S. Dak., Mont., Col.

Exsic: Sydow Ured. 1370. Griffiths West Am. Fg. 273, but not 273a.
Photo: 13A. From Decorah, Ia.

On Thalictrum polygamum Muhl., T. pupurascens L., T. dioicum L., and Thalictrum sp. Penn., Utah, Mont., Ia., Calif., Wyo., Wisc., Col., N. Y., Conn.

Exsic: Syd. Ured. 1281, Ellis. N. A. F. 1042. Rabh. Fg. eur. 2907. Baker. E. & T. Pls. S. Col. 1066. Nelson. Pls. Yellowst. Park. 6389.
Photo: No. 13B. On Thalictrum polygamum. Penna.

The specimens collected in Colorado by Professor Crandall, and in Montana by Kelsey, labeled respectively Anemone parviflora and Anemone multifida (see Jour. Mycol. 8:171. 1902), are Pulsatilla hirsutissima.

This species is quite distinct from Puccinia fusca. I am, however, unable to separate it from Puccinia Thalictri. It is said that Puccinia Pulsatillae has rather longer teleutospores, with rather larger tubercles, but a comparison of a very extensive series of specimens from all parts of the world shows that all supposed distinctions fail.

The teleutospores on Thalictrum and on Pulsatilla have a peculiar habit of adhering in clusters of 3-12 spores, united by the pedicels at the base, a little point in favor of their identity.

CLEMATIS.

14. Puccinia stromatica B. & C.

Grev. III:53. 1874.

III. Teleutosori on the stems, small, confluent up to 15mm. in length, black; teleutospores elliptical to oblong, apex rounded, not at all or slightly thickened, base mostly rounded, wall 2–3μ thick, smooth, dark chestnut-brown, 28—34×16—22μ; pedicel slightly tinted, delicate, flexuous, persistent, up to 80μ long.

On stems of Clematis. Moulton, Alabama.

Photo: No. 14. Top of Plate 5.

This has not since been collected, and my specimen is too small to say whether the host is correctly determined or not.

TRAUTVETTERIA.

15. Puccinia Trautvetteriae Syd. & Holw.

Syd. Monogr. Ured. 1:552. 1903.

III. Spots yellowish-brown; teleutosori black, compact, hypophyllous, suborbicular, 1–3mm. in diameter, scattered, mostly few on a leaf; teleutospores

smooth, thin-walled, pale brown, occasionally constricted, apex rounded, truncate, or rarely acute, sometimes slightly thickened, lower cell narrowed to the short, brown pedicel, 40—60×10—16μ.

On Trautvetteria grandis Nutt. Wash., Idaho, Vancouver Island.

Photo: No. 15. From the type specimen. Wash.

RANUNCULUS. CYRTORYNCHA.

16. Pucinnia diffusa Holway nov. nom.

Syn: Puccinia Ranunculi Seym. Bot. Gaz. 9:191. 1884.

III. Teleutosori amphigenous, but mostly epiphyllous, irregularly scattered, often crowded, not confluent, occupying large areas, or the whole leaf surface, little elevated, ½–¾mm. in diameter, surrounded by the ruptured epidermis, pulverulent. Teleutospores light brown, broadly elliptical, little or not at all constricted at the septum, both ends rounded, apex not thickened, thickly but very minutely tuberculate, 28—40×20—28μ; pedicel hyaline, fragile, short, sometimes more or less laterally inserted.

On Ranunculus repens L. Ills.

Photo: No. 16. From the type collection.

The original description says, "apex rarely with a low, pale apiculus," but this was not visible in the specimen examined. One-celled spores occur, nearly as large as the two-celled, and some very small spores are found. The teleutospores sometimes germinate in the sorus in June. An inconspicuous species and easily overlooked.

17. Puccinia Ranunculi Blytt.

Forh. Vidensk.—Selsk. :—(12). 1882.
(Not P. Ranunculi Seym.)

Syn: Puccinia Blyttiana Lagerh. Bot. Not. :169. 1892.
Puccinia Nuttallii Ellis & Everh. Bull. Torr. Bot. Club 24:283. 1897.

III: Sori amphigenous, confluent on the leaves in round groups 1–3mm. in diameter, elongated on the petioles, often to several mm. in length, brown, pulverulent. Teleutospores elliptical to oblong, often angular and irregular, sometimes rounded at both ends, or with the lower cell narrowed to the pedicel, not at all or considerably constricted at the septum, brown, with a few longitudinal ridges and a few irregular elevations, wall 3–4μ thick, apex and germ-pore of lower cell with a pale papilla, 32—48×20—28μ; pedicel hyaline, fragile.

Ranunculaceae.

On Cyrtoryncha neglecta Greene. Col. C. ranunculina Nutt. Wyo. Ranunculus Escscholtzii Schlecht. Utah.

Photo: No. 17. From the Utah specimen.

Lagerheim changed the name of this species from P. Ranunculi to P. Blyttiana, saying: "Jedoch kann sie den Namen Ranunculi nicht beibehalten, weil Seymour seine gleichnamige Art früher beschrieben hat." I can account for this statement only by supposing that he was depending upon volume VII of Saccardo's Sylloge, published in 1888, in which only Seymour's species is given, without date of publication. Lagerheim describes the teleutospores as "verrucis majoribus ornata," and Sydow as "verrucis majoribus distantibus obsitis," and his figures of them show a few very large flat tubercles.

I have seen no specimens of this species, but Fisher, in his fine work, "Die Uredineen der Schweiz," just issued, gives drawings of the spores which agree in every particular with our species. His measurements differ from mine only 1μ, and his description is exactly the same. He says: "Die Form auf Ranunculus alpestris hat nach Lagerheim ein perenniriendes Mycel und in der That besetzen in den Original-exemplaren, die mir Herr Prof. v. Lagerheim gütigst zur Einsicht sandte, die Teleutosporenlager in Menge die ganze Blattunterseite und den Blattsteil; in den von Herrn W. Tranzschel und mir gesammelten Exemplaren waren dagegen die Gruppen von Teleutosporenlagern immer nur vereinzelt, so dass hier an ein perennirendes Mycel nicht zu denken war.

Lagerheim bezeichnet die Sporenmembran als mit grossen flachen Warzen besetzt, und Sydow bildet kräftige, weit von einander abstehende Warzen ab. Ich konnte, auch in den Originalexemplaren, in der Flächenansicht der Membran keine deutliche Warzen erkennen, vielmehr war die Skulptur eine sehr undeutliche; mitunter konnte ich längs oder quer verlaufende Wülste oder Leisten, meist aber nur unbestimmte grobe Unebenheiten erkennen."

BERBERIDACEAE.

BERBERIS.

18. Puccinia mirabilissima Peck.

Bot. Gaz. VI:226. 1881.

Syn: Uropyxis mirabilissima (Peck) Magn. Ber. deutsch. bot. Ges. X:193. 1902.

Spots red or dark purple. Sori hypophyllous, punctiform to 1mm. in diameter, scattered, few on a leaf, surrounded by the ruptured epidermis.

II. Uredosori brown; uredospores yellowish-brown, subglobose, ovate, or pyriform, on slightly tinted or hyaline pedicels up to 100μ long, closely and minutely verrucose, wall 4μ thick, 28—44×18—26μ, germ-pores 2–5, nearly equatorial, never in two rows.

III. Teleutospores brown, intermixed with the uredospores, and sparingly developed, elliptical to oblong-elliptical, rounded at both ends, apex not thickened, constricted at the septum, verrucose, 28—34×22—24μ; pedicel hyaline, persistent, about 6μ wide and up to 160μ long.

On Berberis Aquifolium Pursh. B. nana Greene. B. nervosa Pursh. B. pinnata Lag. B. pumila Greene. Ore., Calif., Mont., Utah, Ariz., Col., Idaho, Wash.

Exsic. Sydow Ured. 879. 1777. Baker E. & T. Pls. S. Col. 1060. Ellis N. A. F. 1451. 1860. 2243. Heller Idaho Pls. 3190. Nelson Pls. Wyo. 5625. Griffiths West Am. Fg. 265. Garrett Fg. Utah. 10. Baker Pls. S. Col. 60. Rabh. Fg. eur. 3619.

Photo: No. 18A. From Berberis nervosa. Calif.
No. 18B. From Berberis nana. Wyo.

The teleutospores have two germ-pores in each cell, and occasionally three in the upper cell, and the epispore is composed of three layers. It has not been satisfactorily determined whether this species has an aecidium or not. On account of the germ-pores, Magnus has placed it under Uropyxis, but I have retained it under Puccinia in order to have it appear on the same plate with the following species, and because it does not appear to me to fully agree with the other species of Uropyxis.

19. Puccinia Texana Holw. & Long.

Bull. Torr. Bot. Cl. 29:113. 1902.

Sori hypophyllous on reddish-brown spots, sometimes confluent, about 1mm. in diameter, cinnamon-brown, surrounded by the ruptured epidermis, rather firm.

II. Uredospores light brown, on long hyaline pedicels, up to 80μ long, globose to ovate, minutely echinulate, wall 4μ thick when mature, germ-pores 4–8, in two zones on either side of the equator, 24—30×20—26μ.

III. Teleutospores intermixed with the uredospores, cinnamon-brown, smooth, elliptical, rounded at both ends, slightly constricted, apex sometimes a little thickened, when dry both ends collapsing inwards, 28—36×24—28μ; pedicel hyaline, up to 120μ long.

On Berberis trifoliolata Moricand. Austin, Texas.

Photo: No. 19. Type collection.

20. Puccinia Berberidis-trifoliae Diet. et Holw.

Bot. Gaz. XXXI:328. 1901.

III. Spots brown or purple; sori hypophyllous, firm, strongly pulvinate, black, 1–3mm. in diameter, linear on the petioles; teleutospores brown, quite variable in form and size, elliptical, oblong, or fusiform, apex rounded, conical, or prolonged into a point obliquely, mostly rounded at the base, little constricted, apex variously thickened according to the form of the spore, smooth, 24—45×14—24μ; pedicel rather longer than the spore, firm, tinted; one-celled teleutospores are rather common.

On Berberis trifolia Schult. Mexico.

Photo: No. 20. From the type specimen.

PODOPHYLLUM.

21. Puccinia Podophylli Schw.

Schrift. nat. Ges. Leipzig :72. 1822.

Syn: **Aecidium Podophylli Schw.** l. c. :66. 1822.
Puccinia aculeata Link. } Linn. Sp. Plant. 6^2:79. 1825.
Puccinia Podophylli Link. }
Puccinia aurea Spreng. Linn. Syst. Veg. 4^1:568. 1827.
Caeoma Podophyllatum. Schw. Proc. Am. Phil. Soc. 4:293. 1834.
Puccinia aculeata Schw. l. c. :296. 1834.

O. Spermogonia yellowish, minute, epiphyllous, opposite the aecidia, not always present.

I. Aecidia on yellow spots, hypophyllous, orange-red, the early ones in round or irregular clusters, often confluent into large groups, the later ones which accompany the teleutospores, in small groups, 2–6mm. in diameter, crowded, low, margin reflexed, much divided; aecidiospores orange, globose, angular, or elliptical, minutely verrucose, 20—32×16—24μ.

III. Teleutosori hypophyllous, dark brown, usually in angular, irregular groups, 1–10mm. in diameter, on yellow spots, or more rarely spots none, and the

sori scattered over the entire leaf; teleutospores elliptical to oblong, apex not thickened, mostly rounded, sometimes constricted, lower cell often narrowed to the short hyaline fragile pedicel, sparingly furnished with long (to 8μ) pale spines.

On Podophyllum peltatum L. Dist. of Columb., N. Y., Penn., Ohio, Ala., Ky., Va., Mo., Wisc., Ia., Kans., Minn., S. Car.

Exsic: Thuem. Mycoth. univ. 547. 626. Syd. Ured. 76. 1318. 1378. Kellerm. Ohio Fg. 13. 55. Seym. & E. Econ. Fg. 253. Ellis N. A. F. 257. 258. Rabh. Fg. eur. 2911. 2912. Roum. Fg. Gall. 2429.

Photo: No. 21. From Decorah, Ia.

PAPAVERACEAE.

CAPNOIDES. (CORYDALIS.)

22. Puccinia Brandegei Peck.

Bot. Gaz. VII:44. 1882.

III. Teleutosori reddish-brown, amphigenous, forming small clusters on the leaves, but confluent and elongated on the stems up to 30mm. in length, at first covered by the epidermis, which remains surrounding the sori, pulverulent. Teleutospores elliptical, light brown, faintly verrucose, usually rounded at both ends, apex not thickened, but with a minute hyaline papilla, 28—36×16—24μ; pedicel hyaline up to 60μ long, very fragile.

On Capnoides Brandegei (Wats.) Heller. Col.

Photo: No. 22. From the type specimen.

BROMELIACEAE.

PITCAIRNIA.

23. Puccinia Pitcairniae Lagerh.

Bull. Soc. Mycol. de Fr. XI:214. 1895.

Sori hypophyllous, scattered, punctiform to 1mm. in length.

II. Uredosori light brown, covered by the epidermis, which usually opens by a slit, and remains covering the sori; uredospores globose, or subglobose, yellowish-brown, echinulate, spines distant, 24—36μ in diameter, wall 4μ thick.

Bromeliaceae.

III. Teleutosori black, ruptured epidermis prominent; teleutospores brown, smooth, ovoid to oblong, apex rounded, up to 12μ thick, slightly constricted at the septum, lower cell usually narrowed to the pedicel, 40—52 $\times$20—28μ; pedicel tinted, persistent, up to 80μ long. One-celled spores are quite common.

On Pitcairnia Palmeri Wats. Mexico.

Photo: No. 23. Specimen from Chapala, Mex.

COMMELINACEAE.

COMMELINA.

24. Puccinia Commelinae Holw.

Ann. Mycol. II:393. 1904.

Spots yellow, or in old specimens, brown, irregular.

II. Uredosori hypophyllous, light brown, surrounded by the ruptured epidermis; uredospores globose to ovate, light brown, echinulate, 24—32$\times$24—28μ, germ-pores 2.

III. Teleutosori hypophyllous, compact, punctiform, scattered, sometimes covering the entire leaf, giving it an uniform brown color, usually clustered in small groups; teleutospores constricted, surrounded by brown paraphyses, smooth, brown, oblong, clavate, linear, or arcuate, apex rounded, acute, or truncate, not at all thickened, or up to 8μ thick, often truncate with a sharp projection at one corner, 44—68$\times$16—24μ; pedicel short, brown, rarely hyaline.

On Commelina coelestis Willd., C. pallida Willd., and other species of Commelina. Mexico.

Photo: No. 24. On Commelina sp. Chapala, Mex.

JUNCACEAE.

JUNCOIDES. (LUZULA.)

25. Puccinia obscura Schroet.

Nuov. Giorn. Bot. Ital. IX:256. 1877.

Syn: Puccinia Bellidis Lagerh. Tromsö Mus. Aarhefter 17:50. 1894.

Sori amphigenous, mostly hypophyllous, causing more or less discoloration of the leaf, and spots varying from yellow to brown, minute to 1mm. in length.

II. Uredosori light brown, covered by the epidermis, finally becoming pulverulent; uredospores light brown, echinulate, germ-pores 2, 24—28×20—24μ in diameter.

III. Teleutosori dark brown, soon naked, but remaining surrounded by the epidermis; teleutospores smooth, brown, apex darker, rounded and variously thickened up to 8μ, more rarely truncate, or with a conical point, 32—48×16—22μ; pedicel hyaline up to 50μ long, somewhat persistent.

On Juncoides campestre (L) Kuntze. Mass. Juncoides sp. Wash.

Exsic: Seym. & Earle Econ. Fg. 53. Ellis N. A. F. 1469.
Photo: No. 25. On Juncoides, Wash.

Plowright, Jour. Linn. Soc. XX:511, 1884, reports his culture experiments with this species, showing that the aecidial stage occurs on Bellis perennis. He says: "This aecidium differs from its allies in the time that it appears, namely, during the late autumn and winter months, from November to January. * * * The subjoined cultures were then made; the only point about which calling for remark is the length of time which elapsed between the placing of the promycelial spores upon the host plant and the subsequent appearance of the spermogonia. In most uredines only about a week or ten days elapse before the parasite makes its presence visible."

Juncoides campestre was infected Nov. 19, 1883, with aecidiospores, and uredospores appeared Jan. 20, 1884; four plants of Bellis perennis were infected with teleutospores from Juncoides campestre on Dec. 12, 1883, and spermogonia appeared on all Jan. 6, 1884, and aecidia on three Jan. 25, 1884, and on the other on Feb. 8. Plowright attributes the slow growth to the season of the year.

No other cultures have been made, and the aecidial host plant is not known for North America.

Vestergren, Hedw. XLII:90, 1903, says: "Prof. Dr. G. Lagerheim theilt mir mit, dass er in Portugal Puccinia obscura und Aecidium Bellidis in solcher Weise zusammenwachsend gesehen habe, dass es wahrscheinlich war, dass die beiden Formen in genetischem Zusammenhang standen. Um so auffälliger ist es nun, dass diejenige Puccinia obscura, welche ich in Schweden und auf Oesel beobachtet habe, nie von Aecidium Bellidis begleitet gewesen. Bellis perennis ist auf Oesel nur an Zwei Lokalitäten gefunden. Auf Gotland dagegen, wo ich das Auftreten der Puccinia obscura am besten kenne, ist Bellis perenne eine der häufigsten Pflanzen, Puccinia obscura ist dort auf Luzula campestris nicht selten, nirgends trifft man aber Aecidium Bellidis. Ohne Zweifel ist unsere Puccinia obscura von Plowright's wenigstens in ihrem biologischen Verhalten verschieden."

Lagerheim has also noticed at Freiburg, Germany, that on Luzula maxima Puccinia obscura seldom forms teleutospores, but generally lives through the winter in the uredo stage.

LILIACEAE.

CHROSPERMA. VERATRUM. XEROPHYLLUM. ZYGADENUS.

26. Puccinia atropuncta Peck & Clinton.

Bot. Gaz. IV:171. 1879.

Syn: Puccinia Zygadeni Trelease. Trans. Wisc. Acad. Sc. 6:—(25). 1884.
Puccinia Melanthii Bubak. Oesterr. Bot. Zeitschr. L. :318. 1900.

O. Spermogonia small, brown, between the aecidia.

I. Aecidia about 300μ in diameter, amphigenous, collected in small groups, prominently surrounded by the ruptured epidermis, at first opening by a small pore; pseudoperidia not conspicuous, little incised, not reflexed; aecidiospores yellow, globose, angular, or elliptical, minutely verrucose, 20—26$\times$16—22μ; II. III. Spots none or yellow, becoming dark with age. Sori amphigenous, round to elliptical, minute to 1mm. in length, scattered, surrounded by the ruptured epidermis.

II. Uredosori cinnamon-brown; uredospores brown, globose to elliptical, 20—28 $\times$16—24μ; germ-pores 2.

III. Teleutosori black; teleutospores smooth, brown, oblong-clavate, apex rounded, truncate, or pointed, up to 12μ thick, lower cell narrowed to the pedicel, constricted at the septum, 26—56$\times$16—24μ; pedicel hyaline, about the length of the spore.

On Zygadenus elegans Pursh. Iowa, Wisc.

Exsic: Ellis N. A. F. 1447. Roum. Fg. Gall. 3412. Rabh. Fg. eur. 3218.
Photo: No. 26A. Uredospores from Armstrong, Ia.
No. 26B. Teleutospores, from Wisc.

Also on Veratrum parviflorum Michx. and Veratrum sp. N. Car. Chrosperma muscaetoxicum (Walt.) Kuntze. Penna. Xerophyllum asphodelioides (L.) Nutt. Miss.

Exsic: Rabh. Fg. eur. 3920.
Photo: No. 26C. On Veratrum sp. N. Car.

The only specimen of aecidium seen was collected at Armstrong, Ia., on Zygadenus elegans, by R. I. Cratty. The type specimens of Puccinia atropuncta were on Veratrum Woodii, from Missouri.

27. Puccinia Veratri Duby.

Bot. Gall. 2:890. 1830.

Syn: Puccinia Veratri Niessl. Verh. d. zool.-bot. Ges. Wien. 9:177. 1859.
Puccinia Veratri Clinton. Rep. N. Y. State Mus. Nat. Hist. 27:103. 1875.

Sori minute, amphigenous, often mostly hypophyllous, on pale spots, scattered, rarely confluent, surrounded by the ruptured epidermis.

II. Uredosori brown; uredospores echinulate, pale brown, globose to elliptical, 18—30×18—24μ.

III. Teleutosori brown; teleutospores chestnut-brown, elliptical to oblong, strongly constricted at the septum and readily separating, apex rarely slightly thickened, usually with both cells rounded, occasionally with the lower cell narrowed to the pedicel, verrucose, 28—48×18—26μ; pedicel hyaline, fragile, short.

On Veratrum viride Ait. V. Californicum Durand. Calif., Utah, N. H., Penn., N. Y., Idaho.

Exsic: Thuem. Mycoth. univ. 733. Heller Idaho Pls. 3448. Ellis N. A. F. 1031. Sydow Ured. 1386. 1783.
Photo: No. 27. From V. californicum. Calif.

The specimens on Veratrum viride, in the Eastern U. S. have teleutospores much smaller, thinner-walled and lighter in color than the Western specimens, or those from Europe.

28. Puccinia grumosa Syd. & Holw.

Syd. Monogr. Ured. 1:641. 1903.

I. Aecidia mostly hypophyllous, on yellow spots, solitary or collected in small irregular groups, margin reflexed, incised, white; aecidiospores globose to angular, minutely verrucose, 18–28μ in diameter.

II. III. Sori amphigenous, mostly hypophyllous, minute, round to oblong, covered by the epidermis, which splits longitudinally, only becoming naked when old, pulverulent.

II. Uredosori light brown; uredospores yellowish-brown, globose, minutely verrucose, 22–28μ in diameter; germ-pores numerous, indistinct (6–8?).

III. Teleutosori black; teleutospores elliptical, oblong, ovate, or subclavate, sometimes a little irregular and angular, apex rounded, not thickened, rarely somewhat truncate, constricted at the septum, lower cell mostly rounded, rarely narrowed to the pedicel, minutely punctate, bright chestnut-brown, 32—48×22—32μ; pedicel hyaline, fragile, up to 55μ long.

On Zygadenus elegans Pursh. Wyo., Canada.

Exsic: Griffiths West Am. Fg. 288.
Photo: No. 28B. Uredospores. Type specimen from Banff, Canada.
No. 28A. Teleutospores from the same.

ALLIUM.

29. Puccinia mutabilis Ellis & Gall.

Jour. Mycol. 5:67. 1889.

Sori amphigenous, numerous, round to elliptical, minute to 2mm. in length, covered by the epidermis, which splits longitudinally, pulverulent.

II. Uredosori brown; uredospores pale brown, globose, ovate, or elliptical, minutely verrucose, 20—28×16—24μ; germ-pores inconspicuous, about 6.

III. Teleutosori black; teleutospores cinnamon-brown, smooth, mostly elliptical, occasionally ovate, oblong, or irregular, apex not thickened, both cells usually rounded, rarely with the lower narrowed to the pedicel. 32—44×16—28μ; pedicel hyaline, fragile, about the length of the spore.

On Allium mutabile Michx. A. reticulatum Don. A. Geyeri Wats. Mont., Ore., Wyo.

Photo: No. 29B. Uredospores, from Allium reticulatum, Livingston, Mont.
No. 29A. Teleutospores from the same.

Sydow, in his Monograph, describes an aecidium for this species. I have a part of the type specimen, collected at Sand Coulee, Mont., in 1888, with II and III only, as described, and an aecidium from the Ellis collection labeled Puccinia mutabilis, collected at Bozeman, Mont., in 1889. The latter does not appear to differ from the aecidium of Puccinia alliorum. Sydow reports Puccinia mutabilis from New Mexico.

30. Puccinia alliorum (DC.) Corda.

Icones 4:12. 1840.

Syn: Uredo alliorum DC. Fl. Fr. VI:82. 1815.
Xyloma Allii DC. Fl. Fr. VI:156. 1815.
Puccinia Allii Rud. Linnaea IV:392. 1829.
Puccinia Allii Cast. Cat. des Plantes :201. 1845.
Puccinia rotundata Bon. Abh. d. Nat. Ges. Halle 5:219. 1860.
Puccinia Blasdalei Diet. & Holw. Erythea 1:248. 1893.

I. Aecidia amphigenous, scattered or clustered in small groups, often fully covering the leaves and stems, about one-half mm. high, white, margins reflexed when fully mature and well developed; aecidiospores globose to oblong or polygonal, thin-walled, minutely verrucose, orange-yellow, 20—32×18—24μ.

II. Uredosori light brown, elliptical to oblong, covered by the epidermis which splits longitudinally, pulverulent, soon obliterated by the teleutosori which begin by growing around them and finally grow over them; uredospores with orange-red contents when fresh, nearly colorless when old, globose, echinulate, 24–30μ in diameter; germ-pores numerous, inconspicuous.

III. Teleutosori amphigenous, often covering the entire leaves and stems, minute, round to oblong, scattered or mostly confluent in small irregular groups, sometimes evenly covering the stems for 30mm., often with the uredosori in the center, compact, black, never naked; teleutospores smooth, brown, oblong to oblong-clavate, often broadly oblong and irregular, apex rounded, truncate or obliquely angled, thickened up to 8μ, somewhat constricted at the septum, lower cell rounded or narrowed to the pedicel, 28—60×18—28μ, mostly 40—48×20—24μ; pedicel hyaline, up to 30μ long, subpersistent. Brown compact paraphyses are numerous, and one-celled spores are common.

On Allium acuminatum Hook., A. serratum Wats., Utah, Wash., Calif. Allium sp. Mex.

Exsic: Ellis & Everh. N. A. F. 2989.
Photo: No. 30A. On Allium sativum, Athens, Greece.
No. 30B. Same.
No. 30C. On Allium serratum, Calif. Type collection for Puccinia Blasdalei.
No. 30D. Same.
No. 30E. Same.

The American specimens do not differ from Puccinia alliorum except in the presence of an aecidium, and, in some specimens, slightly smaller teleutospores. The uredospores are identical. Sydow gives as a distinction for Puccinia alliorum, "mesoporis nullis," but several European specimens have one-celled spores.

31. Puccinia granulispora Ell. & Gall.

Bull. Torr. Bot. Cl. 22:61. 1895.

I. Aecidia amphigenous, solitary, scattered, or collected in irregular groups, white, fragile, margin incised, not reflexed; aecidiospores globose to angular, finely verrucose, pale yellow, 22–28μ in diameter.

II. III. Sori amphigenous, oblong, ½–3mm. in length, or confluent on the stems up to 15mm. in length, covered by the epidermis, opening by a longitudinal slit, pulverulent.

II. Uredosori cinnamon-brown; uredospores yellowish, with orange contents when fresh, minutely verrucose, globose or ovate, 24—40×24—36μ; germ-pores large and prominent, about 12.

III. Teleutosori dark-brown; teleutospores clear reddish-brown, very irregular in shape and size, ovate, oblong, clavate, or angular, apex mostly rounded, rarely truncate or pointed, not thickened, somewhat constricted at the septum, lower cell usually narrowed to the pedicel, 40—72×24—36μ; pedicel slightly tinted, about the length of the spore, fragile.

On Allium cernuum Roth. Mont., Idaho, Canada. Allium sp. Wash., Col., Vancouver Is.

Liliaceae.

Photo: No. 31A. From Banff, Canada.
No. 31B. The same.

The above description is that of the typical form. The specimens collected at Eatonville, Wash., Idaho and Vancouver Island undoubtedly belong here on account of the typical uredospores, but they have abundant brown paraphyses and the apices and walls of the spores are slightly thickened. Judging from all the collections yet seen, the character of the large uredospores with the 12 large and prominent germ-pores is constant and distinctive. No specimens of Puccinia alliorum from Europe or America show the germ-pores readily even after long heating in lactic acid. The photographs show the distinctions finely. The uredospores of Puccinia alliorum rarely exceed 28μ in diameter, while those of Puccinia granulispora are frequently 36–40μ. The Allium rusts are so extremely variable that it is possible more abundant collections will require the uniting of these species.

BRODIAEA.

32. Puccinia nodosa Ell. & Hark.

Bull. Calif. Acad. Sc. 1:27. 1884.

Sori amphigenous, scattered, minute to 3mm. in length, covered by the epidermis, which opens by a longitudinal slit, and remains covering them.

II. Uredosori cinnamon-brown; uredospores yellowish-brown, globose, oblong, or ovate, minutely echinulate, germ-pores numerous, about 12, scattered, 28—40×26—32μ.

III. Teleutosori black; teleutospores black, almost opaque, oblong-elliptical to oblong, apex not thickened, mostly with both cells rounded, rarely with the lower cell narrowed to the base, and more rarely with the upper cell truncate or pointed, not at all or slightly constricted at the septum, covered with tubercles 3–4μ wide, 40—70×26—36μ, with a few irregular spores 40μ in width; pedicel stout, hyaline, fragile, up to 50μ long.

On Brodiaea capitata Benth. Calif.

Exsic. Ellis & Everh. N. A. F. 3572.
Photo: No. 32A. Teleutospores from specimens in N. A. F. 3572.
No. 32B. Uredospores from the same.

Dudley & Thompson, Jour. Mycol. 10:52, 1904, describe an aecidium for this species as follows:

"I. Amphigenous; spots oblong, 1-4mm. long, conspicuous, orange-yellow; aecidia few, irregularly collected in groups, small, short, rising but slightly above the longitudinally slit epidermis, borders very irregularly lacerated, not recurved; spores mostly globose, a few irregularly angular, oblong to obovate, wall medium thick, very minutely tuberculate, 25—37.5×25—37.5."

I am unable at present to separate the aecidia on Brodiaea for the reason that nearly every specimen that I have seen has more than one species on the plant. Puccinia subangulata and Puccinia Dichelostemmae have occurred together in all the collections, and in one case an aecidium was on the same leaves with Puccinia Dichelostemmae; Puccinia nodosa is on the type specimen of Puccinia Moreniana, and Uromyces Brodiaeae, which has an aecidium, is found both in Washington and California.

33. Puccinia Dichelostemmae Diet. & Holw.

Erythea 3:78. 1895.

III. Sori amphigenous, black, oblong, 1–3mm. in length, pulverulent, at first covered by the epidermis, which opens by a longitudinal slit and remains prominent around them; teleutospores broadly elliptical, smooth, dark brown, nearly opaque, wall quite evenly 5–6μ thick, 44—60×36—48μ; pedicel stout, rather fragile, hyaline, up to 80μ long.

On Brodiaea congesta Smith. Wash.

Photo: No. 33. From the type specimen.

34. Puccinia subangulata Holw. n. sp.

III. Teleutosori amphigenous, dark brown, oblong to elliptical, 1–2mm. in length, at first covered by the epidermis which finally splits longitudinally and remains covering them; teleutospores light cinnamon-brown, covered with an irregular network of ridges which are occasionally longitudinal, very irregular in shape and size, broadly elliptical, oblong, or angular, constricted at the septum, apex not thickened, wall thin, 28—44×16—28μ; pedicel hyaline, fragile, about the length of the spore, often inserted laterally. One-celled spores are common.

On Brodiaea congesta Smith. Wash.

Photo: No. 34.

Mr. Suksdorf sent an aecidium, collected in the same locality, which may possibly belong to this species. It is as follows:

Spots yellow; aecidia orange, about ¾mm. high, mostly arranged in two elliptical rows, 2-3mm. in length, 12-30 aecidia in a group, little lacerated at the apex, not reflexed; aecidiospores globose, ovate, or angular, finely tuberculate, wall 2-3μ thick, contents orange when fresh, 22—32 ×20—24μ, peridial cells closely tuberculate, 32—44×20—32μ.

35. Puccinia Moreniana Dudley & Thompson.

Jour. Mycol. 10:53. 1904.

III. Sori hypophyllous, chestnut-brown, round, oblong, or broadly elliptical, up to 3–12mm. long, covered by the epidermis which finally ruptures irregularly, pulverulent; teleutospores light brown, distinctly striate, very irregular in size, elliptical to oblong, apex not thickened, both cells usually rounded, sometimes the lower cell narrowed to the pedicel, and, rarely, the upper cell truncate or obliquely tapering, somewhat constricted at the septum, varying in size from 24×14μ to 44×30μ; pedicel hyaline, slender,

tapering, rough, fragile, up to 60μ long. One-celled spores equally variable are abundant.

On Brodiaea capitata Benth. Calif.

Photo: No. 35. Type specimen.

ALLIUM. CALOCHORTUS.

36. Puccinia Calochorti Peck.

Bot. Gaz. VI:228. 1881.

Syn: Puccinia anachoreta Ell. & Hark. Bull. Calif. Acad. Sc. 1:34. 1884.

Puccinia Holwayi Diet. Hedw. XXXII:29. 1893.

I. Aecidia amphigenous, margin white, incised, reflexed, in small groups, or covering the stems for 50mm. or more; aecidiospores subglobose to polygonal, orange-yellow, minutely verrucose, wall irregularly thickened, mostly about 2μ thick, occasionally 4μ thick at one side, 16—24×14—20μ.

III. Teleutosori amphigenous, minute but often confluent up to 3mm. in length, surrounded by the ruptured epidermis, but early becoming naked and pulverulent, dark brown; teleutospores cinnamon-brown, coarsely tuberculate, broadly elliptical, both cells rounded, apex not thickened, wall quite uniformly 2–3μ thick, seldom constricted, 28—40×20—32μ; pedicel hyaline, fragile, about the length of the spore.

On Allium sp. King's River Canon, Calif. Type of Puccinia Holwayi Diet.

On Calochortus longebarbatus Wats., C. elegans Pursh, C. albus Dougl., C. Gunnisonii Wats., C. Nuttallii T. & G. Calif., Wyo., Utah.

Exsic. Baker E. & T. Pls. S. Col. 1056. 1077. Nelson Pls. Wyo. 7390. Ellis & Everh. Fg. Col. 1953.

Photo: No. 36A. On Allium sp. Calif. Type of Puccinia Holwayi.
No. 36B. Teleutospores on Calochortus elegans. Wash.
No. 36C. Aecidia on Calochortus Gunnisonii, Wyo. Magnified 12 diameters.

The specimens on Allium differ from those on Calochortus in the great variability of the spores, which range from 24×16μ to 44×28μ. There is no question as to the host, which has been examined by Dr. Rydberg.

Dudley and Thompson, Jour. Mycol. 10:52, 1904, describe the uredo of this species as follows: "II. Hypophyllous, sori scattered, sparse or abundant, small, .5-2mm. long, oblong, surrounded by the ruptured epidermis, light yellow; spores globose, 18-23μ in diameter, walls rather thick, finely echinulate." I have been unable to obtain these specimens for examination, but I have a large amount of material, collected at all seasons of the year, and there are no uredospores. The teleutosori are light colored when young and the immature teleutospores examined in water are light colored, globose, and do not show the septum. Heating in lactic acid shows their true character at once. If the uredospores described by Dudley and Thompson belong to this species it is evident that they are rarely produced.

The No. 1077 distributed by Baker, Earle and Tracy, as Puccinia Holwayi, on Allium, seems to me to be Calochortus; my specimen is mostly the aecidial stage and does not differ from the aecidium on Calochortus.

ASPARAGUS.

37. Puccinia Asparagi DC.

Flora Fr. II:595. 1805.

Syn: Puccinia Discoidearum Asparagi Wallr. Flora Germ. IV:222. 1833.
Aecidium Asparagi Lasch. Flora XXXI:509. 1848.
Uredo Asparagi Lasch. Flora XXXI:509. 1848.
Puccinia oxypus Bon. Abhand. d. Nat. Ges. zu Halle 5:219. 1860.

O. Spermogonia yellow, clustered in the center of the groups of aecidia.

I. Aecidia on the stems, scattered or collected in irregular, oblong groups, low, margin incised, not reflexed; aecidiospores yellow, globose to polygonal, finely verrucose, 16–28μ in diameter.

II. Uredosori cinnamon-brown, oblong, sometimes confluent up to 4mm. in length, surrounded by the ruptured epidermis; uredospores globose to ovate, minutely echinulate, 20—32×20—24μ; germ-pores 5.

III. Teleutosori dark-brown, round to oblong or elliptical, often thickly covering the entire plant, pulvinate, firm; teleutospores chestnut-brown, smooth, elliptical to oblong, apex rounded, up to 8μ thick, lower cell mostly rounded, rarely narrowed to the pedicel, slightly constricted, 32—48×18—24μ; pedicel persistent, tinted, varying in the same sorus from short up to 80μ long.

On Asparagus officinalis L. From the Atlantic to the Pacific.

Exsic: Seym. & Earle. Econ. Fg. 500. Ellis & Everh. N. A. F. 3574. Fg. Col. 1568. Kellerm. Ohio Fg. 27.

Photo: No. 37. From Decorah, Ia.

Specimens from Texas, collected by Long, are peculiar in having a large number of one-celled spores.

Sheldon, Science, 16:236, 1902, reports his experiments with cultures of this species. He says: "In many instances teleutospores have followed the production of uredospores, thus giving all the stages of Asparagus rust from inoculations. The most unexpected results have been obtained from inoculations made on the common onion (Allium cepa), all three stages having been produced. Holway reports that he collected aecidia on 'winter onions' the latter part of May, and the writer collected two specimens about a month later. In each of the above instances Asparagus was growing near 'winter onions.' The great similarity of the Asparagus rust (Puccinia Asparagi) and the onion rust (P. porri), together with the results obtained by inoculation and the aecidia recently collected on the onion, is very suggestive of the identity of the two rusts."

In my garden, the row of "winter onions" was next the Asparagus bed, and until the appearance of the Asparagus rust, had been free from the aecidium. Although the aecidium was very abundant it was not followed by the other stages.

CLINTONIA.

38. Puccinia mesomejalis B. & C.

Rep. N. Y. State Mus. 25:111. 1873.

Syn: Puccinia mesomegala B. & C. Grev. III:52. 1874.

III. Teleutosori amphigenous, on orbicular yellow to brown spots which often become confluent and occupy considerable portions of the leaf, minute, at first covered by the epidermis, at length pulverulent, and sometimes confluent, ferrugineus; teleutospores elliptical to oblong, often irregular, minutely verrucose, brown, apex and occasionally the lower cell with a small hyaline papilla, constricted at the septum or not, mostly with both cells rounded, sometimes both more or less narrowed from the septum, or irregular, 28—40×16—24μ; pedicel hyaline, fragile, about the length of the spore.

On Clintonia borealis (Ait.) Raf. Clintonia uniflora (Menzies) Kunth.
N. Y., N. H., Mich., Minn., Wisc., Wash., Ore., Calif., Canada.

Exsic: Ellis N. A. F. 1041. Thuem. Mycoth. univ. 1126. Heller Idaho Pls. 3284.
Photo: No. 38. On Clintonia uniflora. Wash.

ALETRIS.

39. Puccinia Aletridis B. & C.

Grev. III:52. 1874.

Sori amphigenous, scattered over the entire leaf, minute, round, long covered by the epidermis, seldom confluent, pulverulent.

II. Uredosori cinnamon-brown; uredospores brown, globose to ovate, echinulate, spines rather distant, germ-pores 2, 20—26×20—24μ.

III. Teleutosori brown; teleutospores pale brown, oblong to oblong-clavate, apex rounded or obtusely pointed, paler and 4–6μ thick, slightly constricted at the septum, wall thin, cells mostly equal, the lower rarely narrowed to the base, 28—48×12—16μ, rarely an elliptical spore up to 20μ wide; pedicel hyaline, persistent, up to 60μ long.

On Aletris aurea Walt. Aletris farinosa L. Mass., Fla.

Exsic: Thuem. Mycoth. univ. 2230. Ellis N. A. F. 1454. Rabh. Fg. eur. 3119. Roum. Fg. sel. 4825. Nash. Pls. Fla. 2052.
Photo: No. 39. On Aletris farinosa. Mass.

SMILAX.

40. Puccinia Smilacis Schw.

Schrift. d. nat. Ges. Leipzig :72. 1822.

Syn: Uredo Smilacis Schw. l. c. :70. 1822.
Caeoma Smilacis Link. Linn. Sp. Pl. 6^2:9. 1825.
Caeoma (uredo) Smilacis Schw. Proc. Am. Phil. Soc. 4:290. 1834.

Sori hypophyllous, minute, round, scattered or irregularly circinnate, often covering the entire leaf, frequently confluent, ruptured epidermis prominent, often opening in a stellate manner.

II. Uredosori yellowish-brown, pulverulent; uredospores pale brown, subglobose to ovate, minutely echinulate, 20–28μ in diameter; germ-pores inconspicuous.

III. Teleutosori black, firm; teleutospores elliptical to oblong, chestnut-brown, smooth, apex rounded or obtusely pointed, 4–8μ thick, constricted at the septum, lower cell often narrowed to the pedicel, 32—44×16—22μ; pedicel persistent, tinted, the length of the spore and shorter.

On Smilax Bona-nox L., S. glauca Walt., S. hispida Muhl., S. laurifolia L., S. rotundifolia L., Dist. Columb., Fla., Texas, N. J., Ohio, S. Car., Ills., Neb., Ala.

Exsic: Ellis N. A. F. 1062, 1477. Ellis & Everh. Fg. Col. 1660, 1661. Seym. & E. Econ. Fg. 218, 390, 391. Rabh. Fg. eur. 2917. Kellerm. Ohio Fg. 14. Thuem. Mycoth. univ. 30. 1643.
Photo: No. 40. From Smilax glauca. Ohio.

AMARYLLIDACEAE.

COOPERIA.

41. Puccinia Cooperiae Long.

Bull. Torr. Bot. Cl. 29:110. 1902.

All stages on the leaves together. Sori elliptical, 1–3mm. in length, covering epidermis splitting longitudinally and remaining prominently surrounding them.

I. Aecidia often staining the leaf red, in groups 3—6×1—3mm., margin recurved, incised; aecidiospores orange, globose to ovate or polygonal, minutely tuberculate, wall thin, 20—32×20—24μ.

Amaryllidaceae.

II. Uredosori chrome-yellow; uredospores yellow, globose to ovate, minutely echinulate, germ-pores small, inconspicuous, apparently six, equatorial, 24—32×20—26μ.

III. Teleutosori chestnut-brown; teleutospores yellowish-brown, quite irregular in shape and size, elliptical to oblong, or oblong-clavate, apex rounded, truncate, or obtusely pointed, not thickened, lower cell often longer and narrowed to the pedicel, epispore with about four prominent longitudinal ridges, 32—52×20—26μ; pedicel slightly tinted, half the length of the spore or shorter, fragile, often inserted laterally.

On Cooperia Drummondii Herb. C. acuminata Herb. Austin, Texas.

Exsic: Ellis & Everh. Fg. Columb. 1644.
Photo: No. 41. From Cooperia Drummondii.

BOMAREA.

42. Puccinia Bomareae P. Henn.

Hedw. XXXV:242. 1896.

II. Uredosori hypophyllous, lemon-yellow, minute, scattered, pulverulent; uredospores pale yellow, globose, echinulate, 20–26μ in diameter.

III. Teleutosori dark-brown, hypophyllous, collected in small irregular groups, covered by the epidermis; teleutospores lemon-yellow, smooth, surrounded by compact brown paraphyses at the edges of the sori, spores variable in size and shape, oblong to oblong-clavate, often curved, strongly constricted at the septum, apex not at all thickened, or up to 8μ thick, round, truncate, or obliquely pointed, lower cell often longer and narrowed to the pedicel, 32—60×16—24μ; pedicel brown, short, persistent.

On Bomarea acutifolia Benth. B. ovata Mirb. Mexico.

Photo: No. 42. From Bomarea ovata.

IRIDACEAE.

IRIS.

43. Puccinia Iridis (DC) Wallr.

Rabh. Krypt. Fl. 1:23. 1844.

Syn: Uredo Iridis DC. Encycl. VIII:224. 1808.
Uredo Iridis Duby. Bot. Gall. II:898. 1830.
Puccinia clavuligera Iridis Wallr. Fl. Germ. IV:223. 1833.
Caeoma (Uredo) Iridis Schw. Proc. Am. Phil. Soc. 4:290. 1834.
Uredo limbata Iridis Rabh. Krypt. Fl. 1:12. 1844.
Uromyces Iridis Lev. Dict. univ. 12:—(19). 1848.
*Puccinia truncata B. & Br.Ann. & Mag. Nat. Hist. XIII:461. 1854.
Trichobasis iridicola Peck. Rep. N. Y. State Mus. 24:89. 1872.
Puccinia crassivertex Thuem. Bull. Soc. Imp. d. Nat. de Moscou. 52:137, 1877.
Trichobasis Iridis Cooke. Micros. Fungi. Ed. 4:227. 1878.

Spots none or conspicuous and brown, sori amphigenous, or sometimes all hypophyllous, solitary, scattered, or quite evenly covering the leaf, round to oblong, punctiform to 1mm. in length, surrounded by the ruptured epidermis.

II. Uredosori ferrugineus; uredospores yellowish-brown, globose to elliptical, echinulate, wall about 3μ thick, 20—36×20—28μ; germ-pores 5.

III. Teleutosori black; teleutospores oblong to clavate, smooth, light-brown, apex darker, thickened up to 14μ, round, acuminate or truncate, slightly constricted at the septum, lower cell narrowed to the pedicel, 28—56×14—22μ; pedicel brown, the length of the spore or shorter.

On Iris versicolor L., I. Douglasiana Herb., I. longipetala Herb., I. Xiphium L., Calif., Mass., N. Y., Wisc., Ia., Mich.

Exsic: Sydow Ured. 1719. Ellis N. A. F. 249. Fg. Col. 1856. Rabh. Fg. eur. 3314. Thuem. Mycoth. univ. 2042. Waghorne, Newfoundland Fg. 961.

Photo: No. 43. On Iris Douglasiana. Calif.

The only specimens of teleutospores seen from N. A. were collected in California on Iris Douglasiana, by Blasdale.

Waghorne's specimens differ in having smaller uredospores and inconspicuous germ-pores.

ORCHIDACEAE.

CYPRIPEDIUM.

44. Puccinia Cypripedii Arth. & Holw.

Bull. Ia. Agl. Coll. :156. 1884.

Sori hypophyllous, soon naked, pulverulent, surrounded by the ruptured epidermis, rarely confluent.

II. Uredosori cinnamon-brown; uredospores globose to elliptical, brown, echinulate, 16–24μ in diameter, germ-pores 2, at the apex of the spore.

III. Teleutosori black; teleutospores rarely elliptical, mostly oblong-clavate, smooth, light brown, apex darker and 6–10μ thick, mostly rounded, seldom conical or truncate, lower cell narrowed to the pedicel, slightly constricted, 32—44×14—20μ; pedicel persistent, slightly tinted, from one-half to once the length of the spore.

On Cypripedium hirsutum Mill. Decorah, Ia.

Exsic. Ellis N. A. F. 1473. Rabh. Fg. eur. 3511.
Photo: No. 44A. Teleutospores.
No. 44B. Uredospores.

UNKNOWN ORCHID.

45. Puccinia cinnamomea Diet. & Holw.

Bot. Gaz. XXIV:29. 1897.

III. Sori in irregular or linear groups, up to 40×10mm., hypophyllous, punctiform, pulvinate, cinnamon-brown; teleutospores pale brown, smooth, oblong, constricted at the septum, cells easily separating, both ends rounded, or the lower cell narrowed to the pedicel, apex not at all or slightly thickened, 28—38×14—18μ; pedicel hyaline, persistent, slender, the length of the spore and shorter.

On a small terrestial orchid, Cuernavaca, Mex., Sept. 28, 1896.

Photo: No. 45.

The teleutospores germinate in the sorus, and are collapsed and broken so that in sections about one entire spore could be obtained; the photograph furnished is the best that could be done with the material.

The host plants collected were retained by Mr. Pringle, and are misplaced so that no determination of the genus even can now be made.

DESCRIPTIONS OF PLATES.

All figures magnified 250 diameters, unless otherwise noted.

RANUNCULACEAE.

Caltha.

No.

1. Puccinia Calthae Link. Teleutospores on Caltha palustris, Decorah, Ia.
2. Puccinia calthaecola Schroet. Teleutospores on Caltha palustris, Decorah, Ia.
3. Puccinia gemella Diet. & Holw. Teleutospores on Caltha leptosepala. Wash.
4. Puccinia areolata Diet. & Holw. Teleutospores on Caltha biflora. Wash.
5. Puccinia Trelesiana Pazschke. Teleutospores on Caltha leptosepala. Col.

Delphinium.

6. Puccinia Delphinii Diet. & Holw. Teleutospores on Delphinium sp. Calif.

Anemone. Pulsatilla.

7. Puccinia cohaesa Long. Teleutospores on Anemone caroliniana. Texas.
8. Puccinia fusca (Pers.) Wint. Teleutospores on Anemone quinquefolia. Iowa.
9A. Puccinia De Baryana Thuem. Teleutospores on Anemone Drummondii. Mt. Hood, Ore.
9B. Puccinia De Baryana Thuem. Teleutospores on Pulsatilla hirsutissima. Iowa.
9C. Puccinia De Baryana Thuem. Teleutospores on Anemone parviflora. Canada.
10. Puccinia Anemones-Virginianae Schw. Teleutospores on Anemone cylindrica. Iowa.
11. Puccinia gigantispora Bubak. Teleutospores on Anemone globosa. Canada.
12. Puccinia retecta Syd. Teleutospores on Anemone narcissiflora. Col.
13A. Puccinia Pulsatillae (Opiz.) Rostr. Teleutospores on Pulsatilla hirsutissima. Iowa.

Thalictrum.

13B. Puccinia Pulsatillae (Opiz.) Rostr. Teleutospores on Thalictrum polygamum. Pa.

Clematis.

14. Puccinia stromatica B. & C. Top of Plate No. 5. Teleutospores on Clematis sp. Alabama.

Trautvetteria.

15. Puccinia Trautvetteriae Syd. & Holw. Teleutospores on Trautvetteria grandis. Wash.

Ranunculus.

16. Puccinia diffusa Holw. Teleutospores on Ranunculus repens. Ills.
17. Puccinia Ranunculi Blytt. Teleutospores on Ranunculus Escscholtzii. Utah.

BERBERIDACEAE.

Berberis.

18A. Puccinia mirabilissima Peck. Uredospores on Berberis nervosa. Calif.
18B. Puccinia mirabilissima Peck. Teleutospores on Berberis nana. Wyo.
19. Puccinia Texana Holw. & Long. Teleutospores on Berberis trifoliolata. Texas.
20. Puccinia Berberidis-trifoliae Diet. & Holw. Teleutospores on Berberis trifolia. Mexico.

Podophyllum.

No.
21. Puccinia Podophylli Schw. Teleutospores on Podophyllum peltatum. Iowa.

PAPAVERACEAE.

Capnoides. (Corydalis.)

22. Puccinia Brandegei Peck. Teleutospores on Capnoides Brandegei. Col.

BROMELIACEAE.

Pitcairnia

23. Puccinia Pitcairniae Lagerh. Teleutospores on Pitcairnia Palmeri. Mexico.

COMMELINACEAE.

Commelina.

24 Puccinia Commelinae Holw. Teleutospores on Commelina sp. Mexico.

JUNCACEAE.

Juncoides. (Luzula.)

25. Puccinia obscura Schroet. Teleutospores on Juncoides sp. Wash.

LILIACEAE.

Veratrum. Zygadenus.

26A. Puccinia atropuncta P. & C. Teleutospores on Zygadenus elegans. Wisc.
26B. Puccinia atropuncta P. & C. Uredospores on Zygadenus elegans. Iowa.
26C. Puccinia atropuncta P. & C. Teleutospores on Veratrum sp. N. Car.
27. Puccinia Veratri Duby. Teleutospores on Veratrum Californicum. Calif.
28A. Puccinia grumosa Syd. & Holw. Teleutospores on Zygadenus elegans. Canada.
28B. Puccinia grumosa Syd. & Holw. Uredospores on Zygadenus elegans. Canada.

Allium.

29A. Puccinia mutabilis E. & G. Teleutospores on Allium reticulatum. Mont.
29B. Puccinia mutabilis E. & G. Uredospores on Allium reticulatum. Mont.
30A. Puccinia alliorum (DC.) Corda. Teleutospores on Allium sativum, Athens, Greece.
30B. Puccinia alliorum (DC.) Corda. Teleutospores on Allium sativum, Athens, Greece.
30C. Puccinia alliorum (DC.) Corda. Teleutospores on Allium serratum. Calif.
30D. Puccinia alliorum (DC.) Corda. Teleutospores on Allium serratum. Calif.
30E. Puccinia alliorum (DC.) Corda. Uredospores on Allium serratum. Calif.
31A. Puccinia granulispora E. & G. Uredospores on Allium cernuum. Canada.
31B. Puccinia granulispora E. & G. Teleutospores on Allium cernuum. Canada.
36A. Puccinia Calcochorti Pk. Teleutospores on Allium sp. Calif.

Brodiaea.

No.
32A. Puccinia nodosa E. & H. Teleutospores on Brodiaea capitata. Calif.
32B. Puccinia nodosa E. & H. Uredospores on Brodiaea capitata. Calif.
33. Puccinia Dichelostemmae D. & H. Teleutospores on Brodiaea congesta. Wash.
34. Puccinia subangulata Holw. Teleutospores on Brodiaea congesta. Wash.
35. Puccinia Moreniana D. & T. Teleutospores on Brodiaea capitata. Calif.

Calochortus. Allium.

36A. Puccinia Calochorti Peck. Teleutospores on Allium sp. Calif.
36B. Puccinia Calochorti Peck. Teleutospores on Calochortus elegans. Wash.
36C. Puccinia Calochorti Peck. Aecidium on Calochortus Gunnisoni. Wyo. 12 diam.

Asparagus.

37. Puccinia Asparagi DC. Teleutospores on Asparagus officinalis. Iowa.

Clintonia.

38. Puccinia mesomejalis B. & C. Teleutospores on Clintonia uniflora. Wash.

Aletris.

39. Puccinia Aletridis B. & C. Teleutospores on Aletris farinosa. Mass.

Smilax.

40. Puccinia smilacis Schw. Teleutospores on Smilax glauca. Ohio.

AMARYLLIDACEAE.

Cooperia.

41. Puccinia Cooperiae Long. Teleutospores on Cooperia Drummondii. Texas.

Bomarea.

42. Puccinia Bomareae P. Henn. Teleutospores on Bomarea ovata. Mexico.

IRIDACEAE.

Iris.

43. Puccinia Iridis (DC.) Wallr. On Iris Douglasii. Calif.

ORCHIDACEAE.

Cypripendium.

44A. Puccinia Cypripedii Arth. & Holw. Teleutospores on Cypripedium hirsutum. Iowa.
44B. Puccinia Cypripedii Arth. & Holw. Uredospores on Cypripedium hirsutum. Iowa.

Unknown Orchid.

45. Puccinia cinnamomea Diet. & Holw. Teleutospores on orchid. Mex.

PLATE I

RANUNCULACEAE.

Caltha.

1. [illegible] on Caltha palustris, Decorah, Iowa, ×250.
2. [illegible] on Caltha palustris, Decorah, Iowa, ×250.
3. [illegible] on Caltha [illegible], Wash., ×250.
4. [illegible] on Caltha biflora, Wash., ×250.
5. [illegible] on Caltha leptosepala, Colo., ×250.

Delphinium.

6. [illegible] on Delphinium sp., Utah, ×250.

PLATE 1

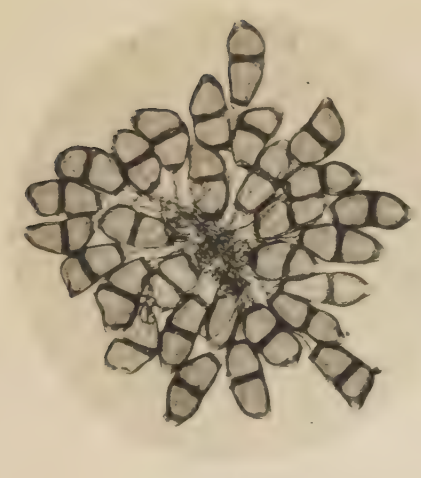
RANUNCULACEAE.

Caltha.

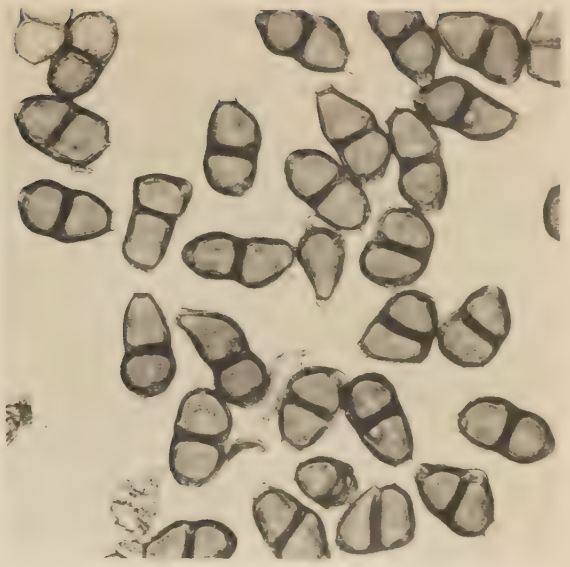
1. Puccinia Calthae Link. Teleutospores on Caltha palustris, Decorah, Iowa, ×250.
2. Puccinia calthaecola Schroet. Teleutospores on Caltha palustris, Decorah, Iowa, ×250.
3. Puccinia gemella Diet. & Holw. Teleutospores on Caltha leptosepala, Wash., ×250.
4. Puccinia areolata Diet. & Holw. Teleutospores on Caltha biflora, Wash., ×250.
5. Puccinia Treleasiana Pazschke. Teleutospores on Caltha leptosepala, Colo., ×250.

Delphinium.

6. Puccinia Delphinii Diet. & Holw. Teleutospores on Delphinium sp., Calif., ×250.

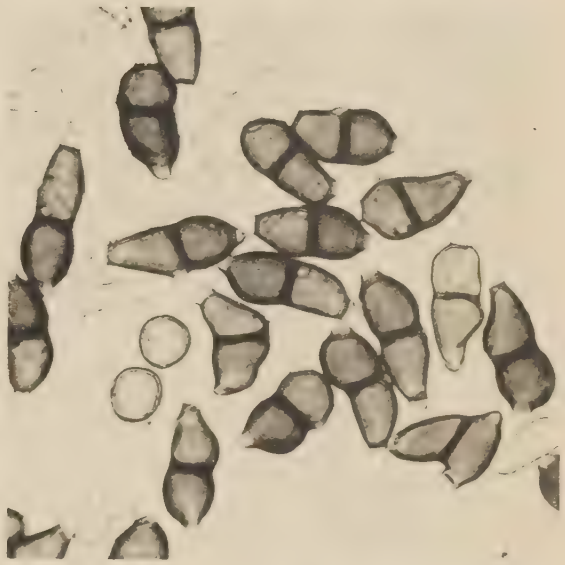


1

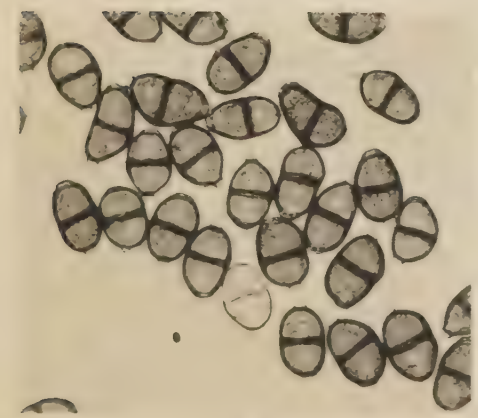


2

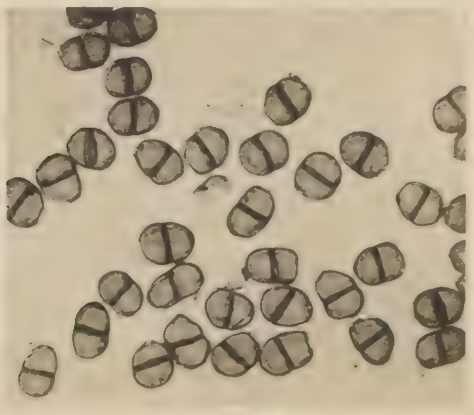
3



4



5



6

PLATE 2

Anemone. Pulsatilla.

7. Puccinia cohaesa Long. Teleutospores on Anemone caroliniana, Texas, ×250.

8. Puccinia fusca (Pers.) Wint. Teleutospores on Anemone quinquefolia, Iowa, ×250.

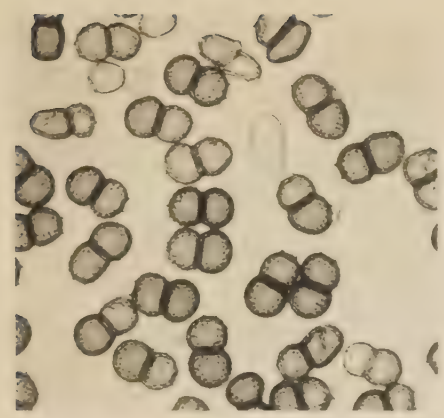
9a. Puccinia De Baryana Thuem. Teleutospores on Anemone Drummondii, Mt. Hood, Ore., ×250.

9b. Puccinia De Baryana Thuem. Teleutospores on Pulsatilla hirsutissima, Iowa, ×250.

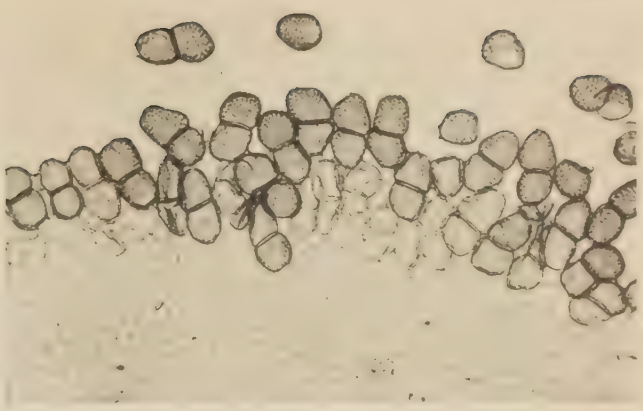
9c. Puccinia De Baryana Thuem. Teleutospores on Anemone parviflora, Canada, ×250.

10. Puccinia Anemones-Virginianae Schw. Teleutospores on Anemone cylindrica, Iowa, ×250.

11. Puccinia gigantispora Bubak. Teleutospores on Anemone globosa, Canada, ×250.

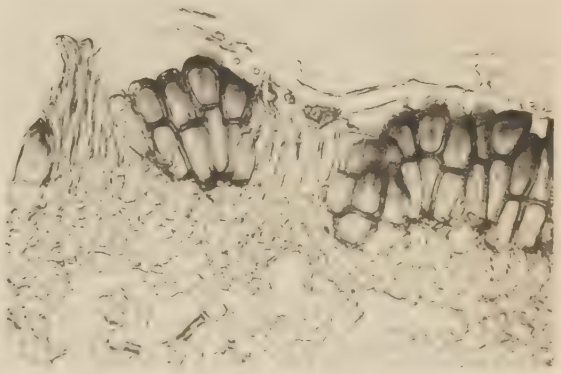


7

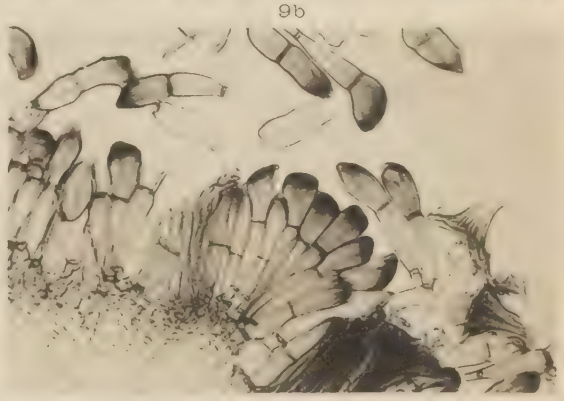


8

9a

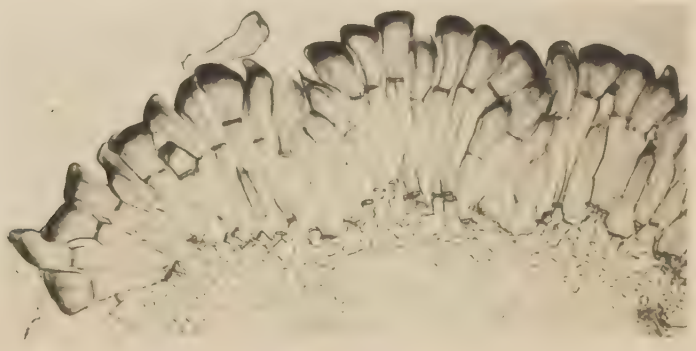


9b



9c

10



11

PLATE 3

Anemone. Pulsatilla—Continued

Thalictrum.

Trautvetteria.

Ranunculus.

16. Puccinia diffusa Holw. Teleutospores on Ranunculus repens, Ill., ×250.

17. Puccinia Ranunculi Blytt. Teleutospores on Ranunculus Eschscholtzii, Utah, ×250.

PLATE 3

Anemone. Pulsatilla—Continued

12. Puccinia retecta Syd. Teleutospores on Anemone narcissiflora, Colo., ×250.

13a. Puccinia Pulsatillae (Opiz) Rostr. Teleutospores on Pulsatilla hirsutissima, Iowa, ×250.

Thalictrum.

13b. Puccinia Pulsatillae (Opiz) Rostr. Teleutospores on Thalictrum polygamum, Pa., ×250.

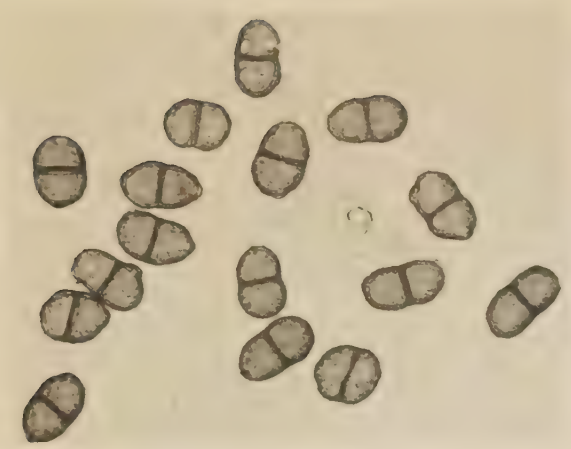
Trautvetteria.

15. Puccinia Trautvetteriae Syd. & Holw. Teleutospores on Trautvetteria grandis, Wash., ×25

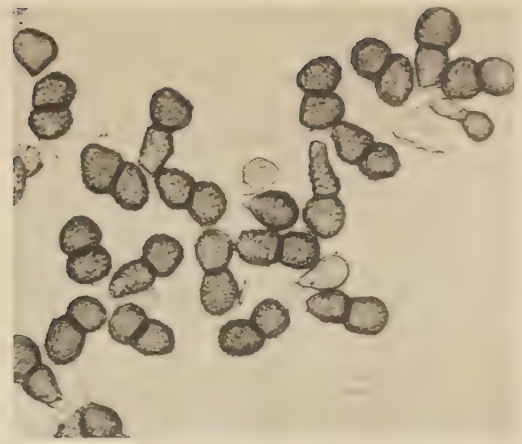
Ranunculus.

16. Puccinia diffusa Holw. Teleutospores on Ranunculus repens., Ill., ×250.

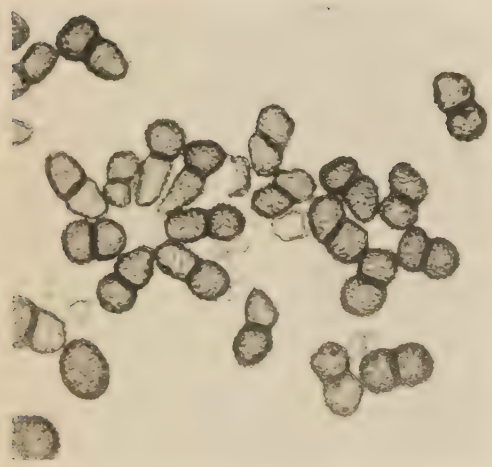
17. Puccinia Ranunculi Blytt. Teleutospores on Ranunculus Escscholtzii, Utah, ×250.



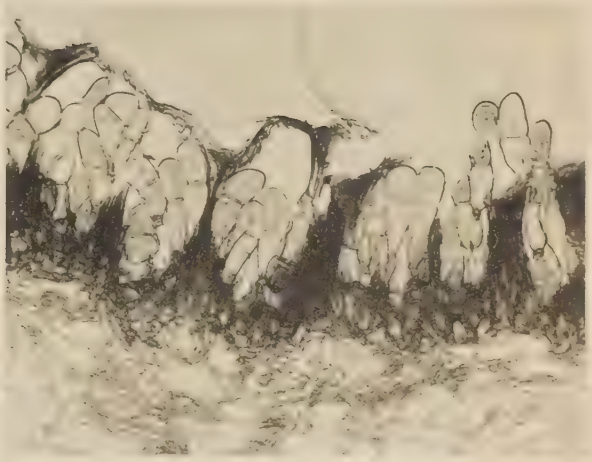
12



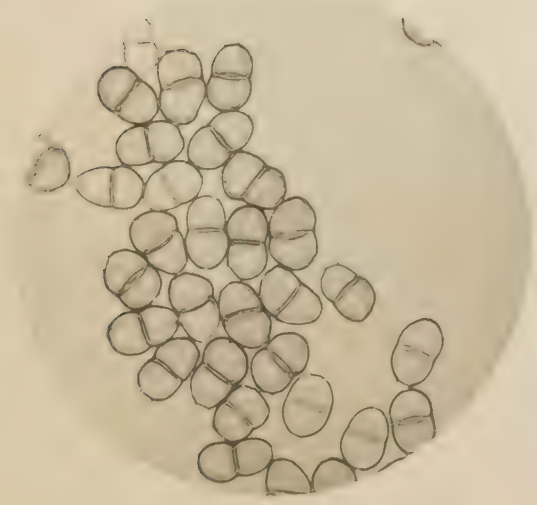
13a



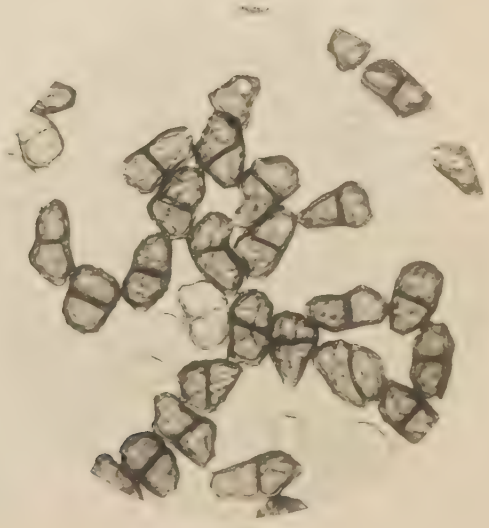
13b



15



16



17

PLATE 4

BERBERIDACEAE.

Berberis.

18a. Puccinia [illegible] Peck. Uredospores on [illegible] nervosa, Calif., ×250.

18b. Puccinia [illegible] Peck. Teleutospores on Berberis nana, Wyo., ×250.

19. Puccinia Texana Holw. & Holw. Teleutospores on Berberis trifoliolata, Texas, ×250.

20. Puccinia Berberidis-trifoliae Diet. & Holw. Teleutospores on Berberis trifolia, Mexico, ×250.

Podophyllum.

21. Puccinia Podophylli Schw. Teleutospores on Podophyllum peltatum, Iowa, ×250.

PAPAVERACEAE.

Capnoides. (Corydalis).

22. Puccinia Brandegei Peck. Teleutospores on Capnoides Brandegei, Colo., ×250.

PLATE 4

BERBERIDACEAE.

Berberis.

18a. Puccinia mirabilissima Peck. Uredospores on Berberis nervosa, Calif., ×250.

18b. Puccinia mirabilissima Peck. Teleutospores on Berberis nana, Wyo., ×250.

19. Puccinia Texana Holw. & Long. Teleutospores on Berberis trifoliolata, Texas, ×250.

20. Puccinia Berberidis-trifoliae Diet. & Holw. Teleutospores on Berberis trifolia, Mexico, ×250.

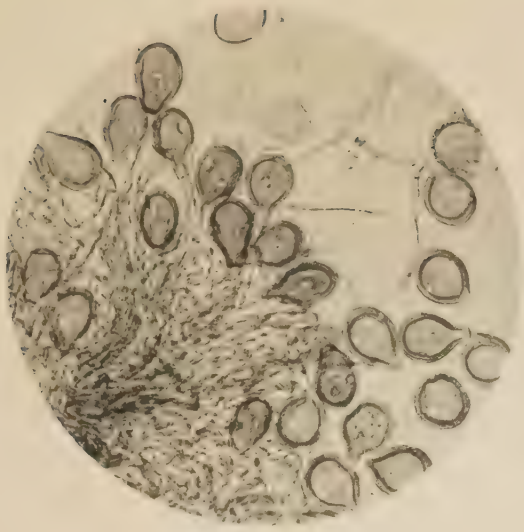
Podophyllum.

21. Puccinia Podophylli Schw. Teleutospores on Podophyllum peltatum, Iowa, ×250.

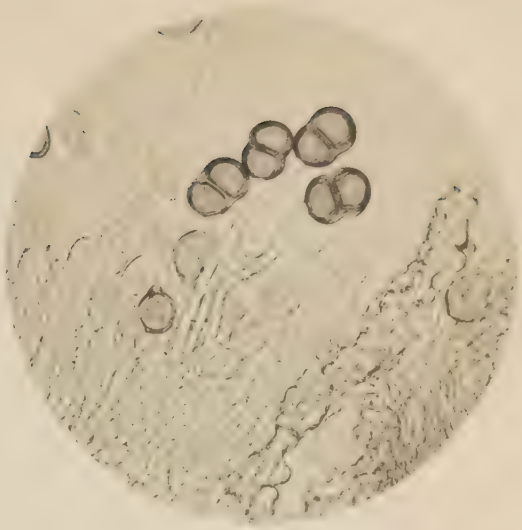
PAPAVERACEAE.

Capnoides. (Corydalis).

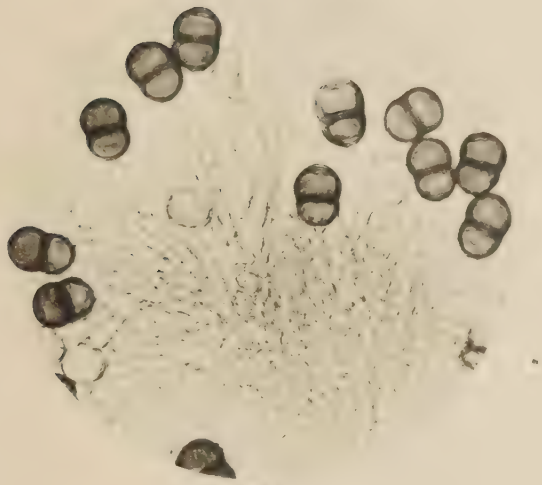
22. Puccinia Brandegei Peck. Teleutospores on Capnoides Brandegei, Colo., ×250.



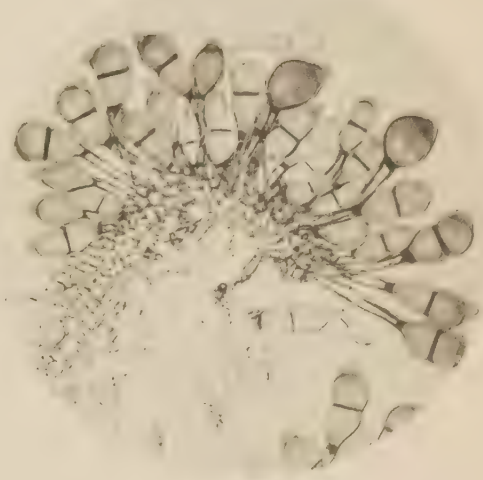
18a



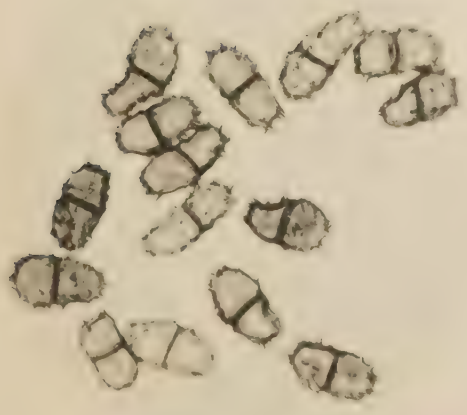
18b



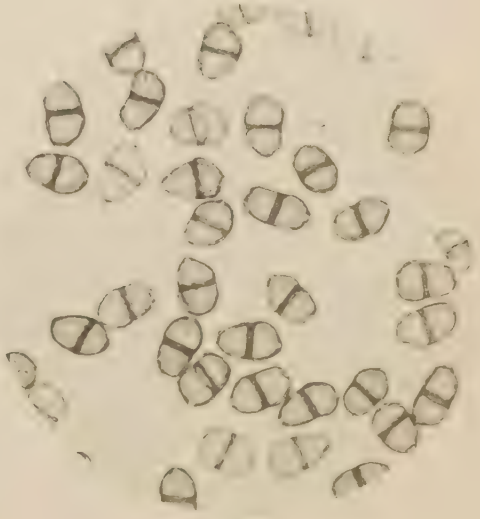
19



20



21



22

PLATE 3

RANUNCULACEAE.

Clematis.

14. Puccinia atromatica B. & C. Teleutospores on Clematis sp., Va., ×250.

BROMELIACEAE.

Pitcairnia.

15. Puccinia Pitcairniae Lagerh. Teleutospores on Pitcairnia Lindeni, Mexico, ×250.

COMMELINACEAE.

Commelina.

24. Puccinia Commelinae Diet. Teleutospores on Commelina sp., Mexico, ×250.

JUNCACEAE.

Juncoides. (Luzula).

25. Puccinia obscura Schroet. Teleutospores on Juncoides sp., Wash., ×250.

LILIACEAE.

Veratrum. Zygadenus.

26a. Puccinia peroxnata P. & C. Teleutospores on Zygadenus elegans, Wis., ×250.

26b. P... Uredospores on Zygadenus elegans, Iowa, ×250.

PLATE 5

RANUNCULACEAE.

Clematis.

14. Puccinia stromatica B. & C. Teleutospores on Clematis sp., Ala., ×250.

BROMELIACEAE.

Pitcairnia.

23. Puccinia Pitcairniae Lagerh. Teleutospores on Pitcairnia Palmeri, Mexico, ×250.

COMMELINACEAE.

Commelina.

24. Puccinia Commelinae Holw. Teleutospores on Commelina sp., Mexico, ×250.

JUNCACEAE.

Juncoides. (Luzula).

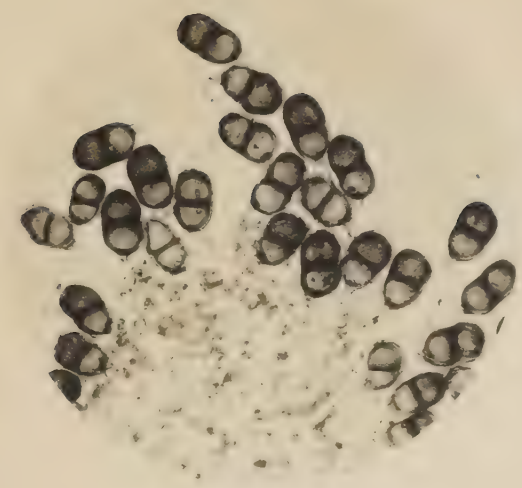
25. Puccinia obscura Schroet. Teleutospores on Juncoides sp., Wash., ×250.

LILIACEAE.

Veratrum. Zygadenus.

26a. Puccinia atropuncta P. & C. Teleutospores on Zygadenus elegans, Wis., ×250.

26b. Puccinia atropuncta P. & C. Uredospores on Zygadenus elegans, Iowa, ×250.

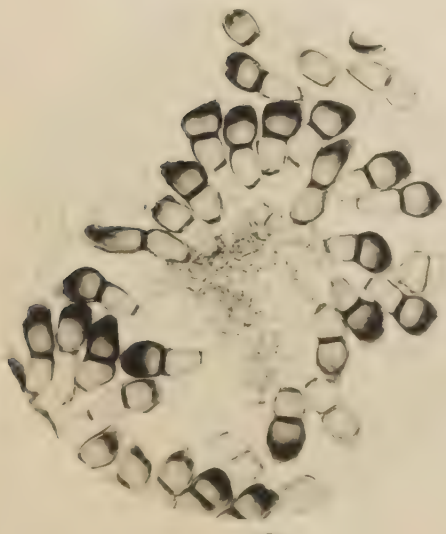


14

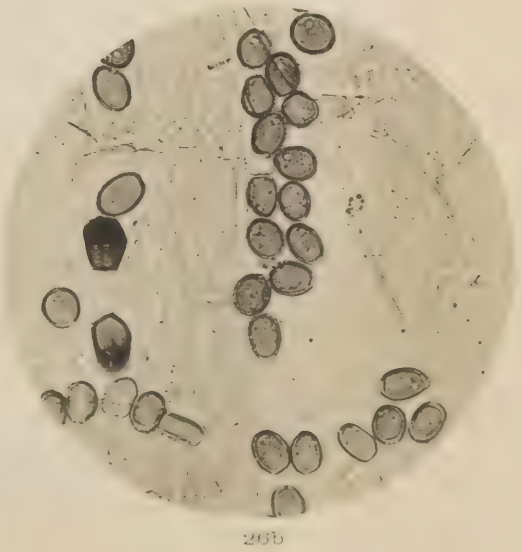
23

24

25



26a



26b

PLATE 6

Veratrum. Zygadenus—Continued

[illegible] Puccinia atropuncta P. & C. Teleutospores on Veratrum sp., N.C., ×250.

[illegible] Puccinia Veratri Duby. Teleutospores on Veratrum tabiornicum, Calif., ×250.

[illegible] Puccinia gruniosa Syd. & Holw. Teleutospores on Zygadenus elegans, Canada, ×250.

[illegible] Puccinia gruniosa Syd. & Holw. Uredospores on Zygadenus elegans, Canada, ×250.

Allium.

[illegible] Puccinia mutabilis E. & G. Teleutospores on Allium reticulatum, Mont., ×250.

[illegible] Puccinia mutabilis E. & G. Uredospores on Allium reticulatum, Mont., ×250.

PLATE 6

Veratrum. Zygadenus—Continued

26c. Puccinia atropuncta P. & C. Teleutospores on Veratrum sp., N.C., ×250.

27. Puccinia Veratri Duby. Teleutospores on Veratrum californicum, Calif., ×250.

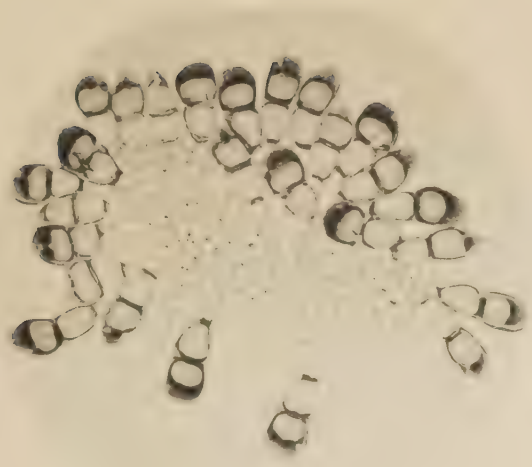
28a. Puccinia grumosa Syd. & Holw. Teleutospores on Zygadenus elegans, Canada, ×250.

28b. Puccinia grumosa Syd. & Holw. Uredospores on Zygadenus elegans, Canada, ×250.

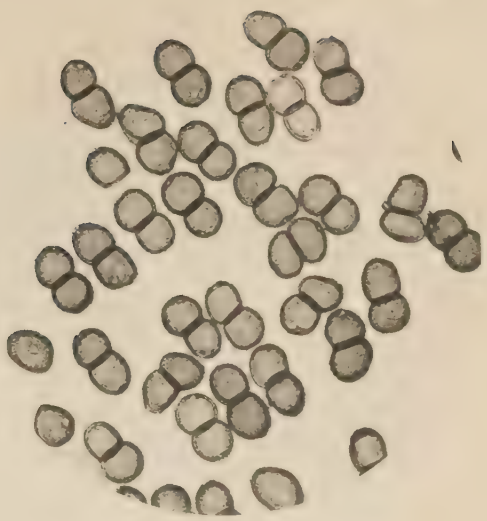
Allium.

29a. Puccinia mutabilis E. & G. Teleutospores on Allium reticulatum, Mont., ×250.

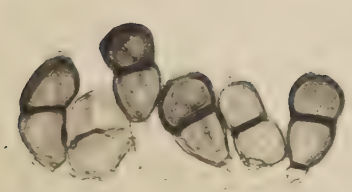
29b. Puccinia mutabilis E. & G. Uredospores on Allium reticulatum, Mont., ×250.



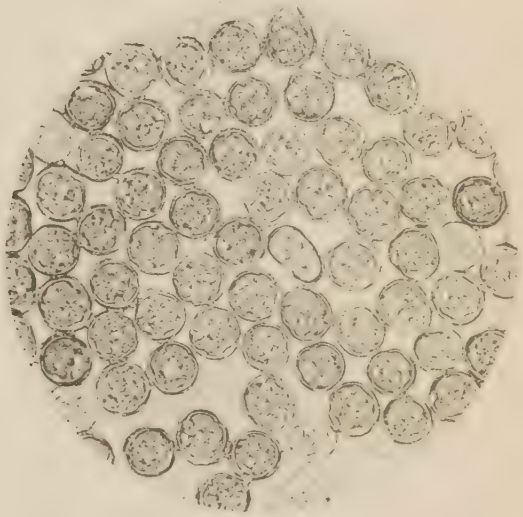
26c



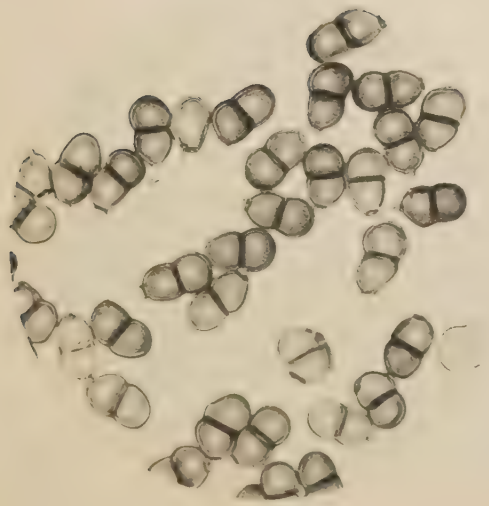
27



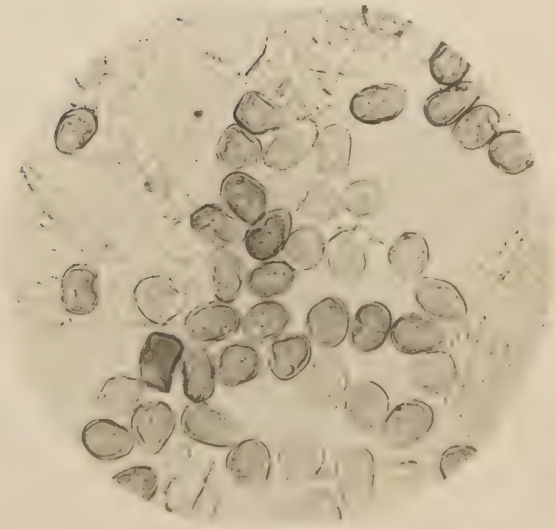
28a



28b



29a



29b

PLATE 7

Allium—Continued

[illegible]	Puccinia alliorum (DC) Corda	Teleutospores on Allium sativum, Athens, Greece, ×250.
[illegible]	Puccinia alliorum (DC) Corda.	Teleutospores on Allium sativum, Athens, Greece ×250.
[illegible]	Puccinia alliorum (DC) Corda	Teleutospores on Allium serratum, Calif., ×250.
[illegible]	Puccinia alliorum (DC) Corda	Teleutospores on Allium serratum, Calif., ×250
[illegible]	Puccinia alliorum (DC) Corda.	Uredospores on Allium serratum, Calif., ×250
[illegible]	Puccinia granulispora B. & C.	Uredospores on Allium cernuum, Canada, ×250.

PLATE 7

Allium—Continued

30a. Puccinia alliorum (DC) Corda. Teleutospores on Allium sativum, Athens, Greece, ×250.

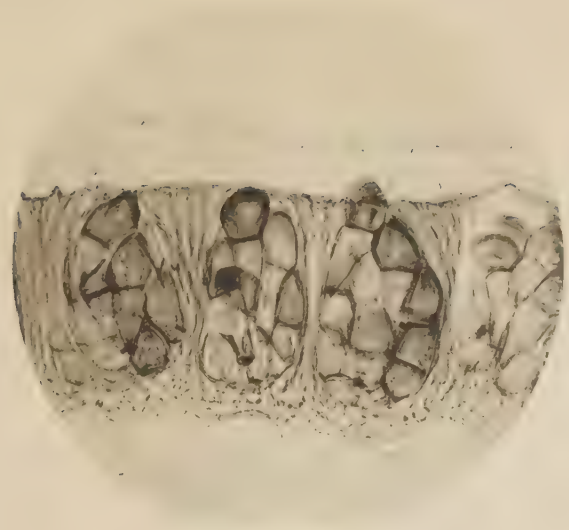
30b. Puccinia alliorum (DC) Corda. Teleutospores on Allium sativum, Athens, Greece, ×250.

30c. Puccinia alliorum (DC) Corda. Teleutospores on Allium serratum, Calif., ×250.

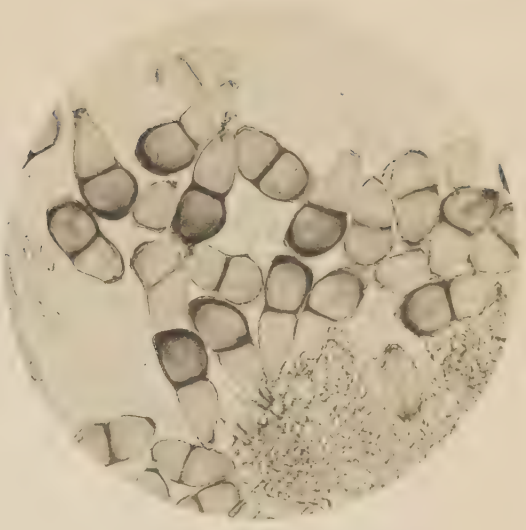
30d. Puccinia alliorum (DC) Corda. Teleutospores on Allium serratum, Calif., ×250.

30e. Puccinia alliorum (DC) Corda. Uredospores on Allium serratum, Calif., ×250.

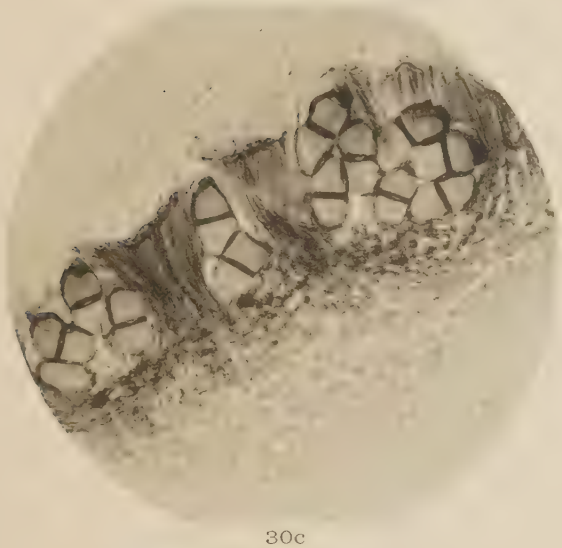
31a. Puccinia granulispora E. & G. Uredospores on Allium cernuum, Canada, ×250.



30a

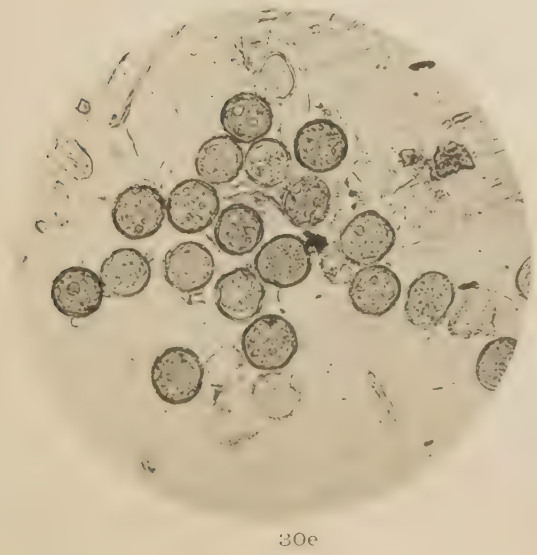


30b

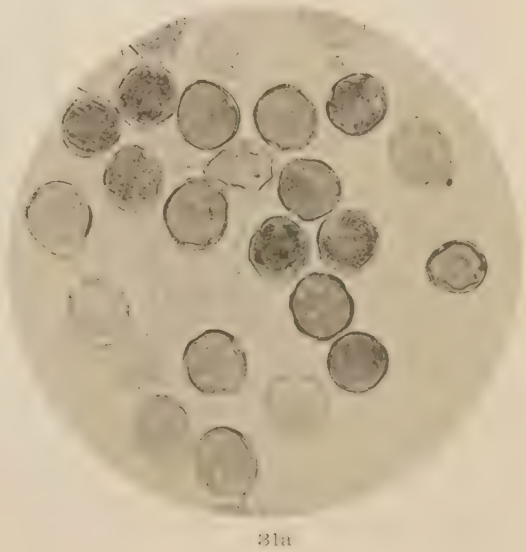


30c

30d



30e



31a

PLATE 8

Allium—Continued

31b. Puccinia granulispora E. & G. Teleutospores on Allium cernuum, Canada, ×250.

Brodiaea.

32a. Puccinia nodosa E. & H. Teleutospores on Brodiaea capitata, Calif., ×250.

32b. Puccinia nodosa E. & H. Uredospores on Brodiaea capitata, Calif., ×250.

33. Puccinia Dichelostemmae D. & H. Teleutospores on Brodiaea congesta, Wash., ×250.

34. Puccinia subangulata Dolw. Teleutospores on Brodiaea congesta, Wash., ×250.

35. Puccinia Morenana D. & T. Teleutospores on Brodiaea capitata, Calif., ×250.

PLATE 8

Allium—Continued

31b. Puccinia granulispora E. & G. Teleutospores on Allium cernuum, Canada, ×250.

Brodiaea.

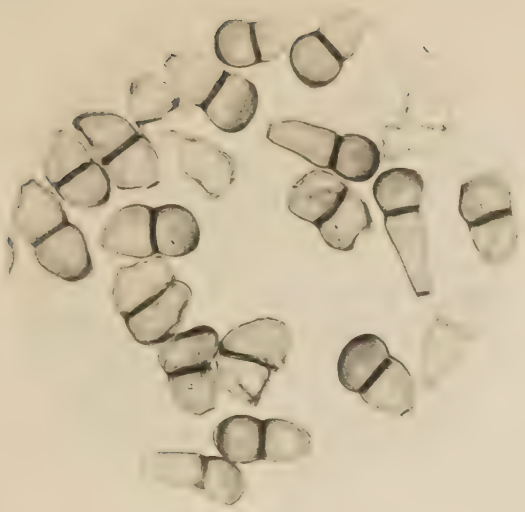
32a. Puccinia nodosa E. & H. Teleutospores on Brodiaea capitata, Calif., ×250.

32b. Puccinia nodosa E. & H. Uredospores on Brodiaea capitata, Calif., ×250.

33. Puccinia Dichelostemmae D. & H. Teleutospores on Brodiaea congesta, Wash., ×250.

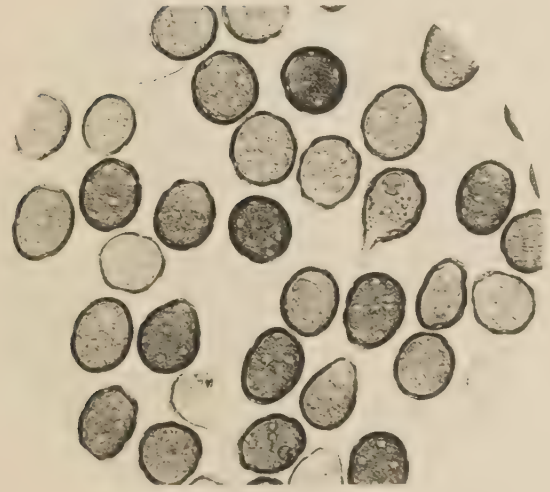
34. Puccinia subangulata Holw. Teleutospores on Brodiaea congesta, Wash., ×250.

35. Puccinia Moreniana D. & T. Teleutospores on Brodiaea capitata, Calif., ×250.

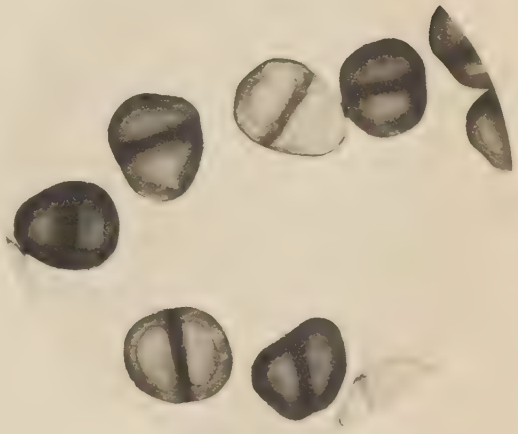


31b

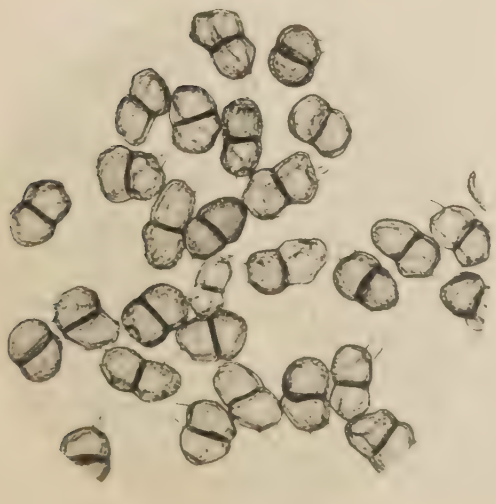
32a



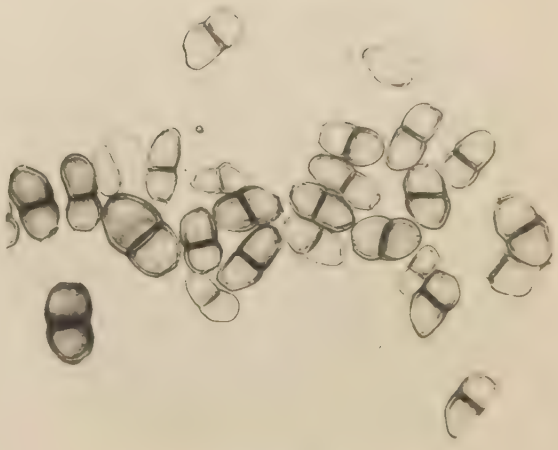
32b



33



34



35

PLATE 9

Calochortus. Allium.

Asparagus.

Clintonia.

Aletris.

39. Puccinia Aletridis B. & C. Teleutospores on Aletris farinosa, Mass., ×250.

PLATE 9

Calochortus. Allium.

36a. Puccinia Calochorti Peck. Teleutospores on Allium sp., Calif., ×250.

36b. Puccinia Calochorti Peck. Teleutospores on Calochortus elegans, Wash., ×250.

36c. Puccinia Calochorti Peck. Aecidium on Calochortus Gunnisonii, Wyo., ×12.

Asparagus.

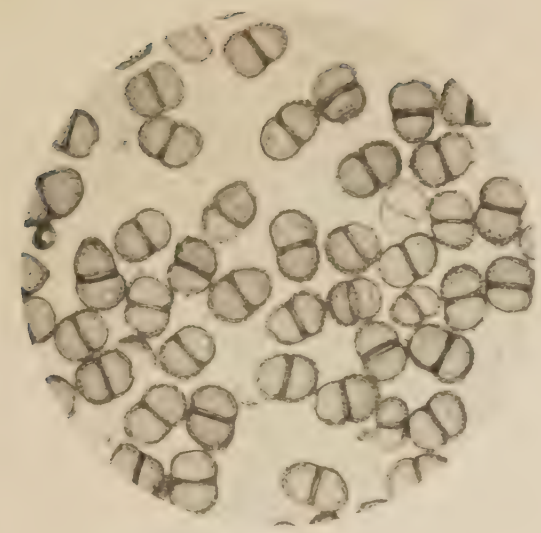
37. Puccinia Asparagi DC. Teleutospores on Asparagus officinalis, Iowa, ×250.

Clintonia.

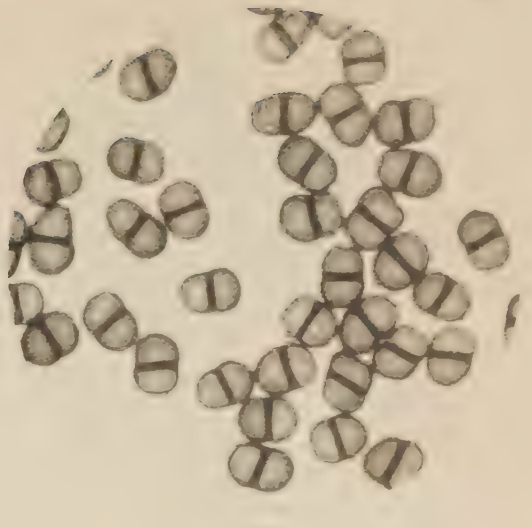
38. Puccinia mesomejalis B. & C. Teleutospores on Clintonia uniflora, Wash., ×250.

Aletris.

39. Puccinia Aletridis B. & C. Teleutospores on Aletris farinosa, Mass., ×250.

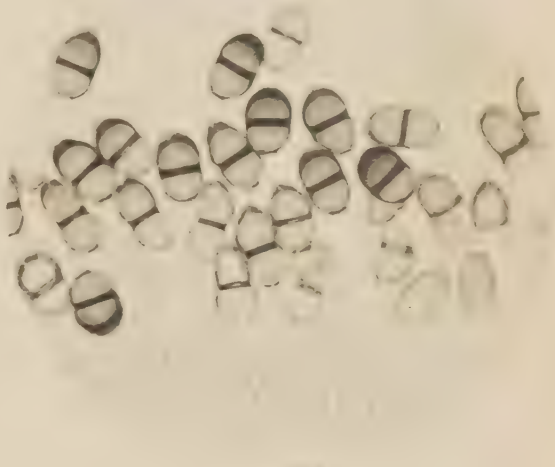


36a

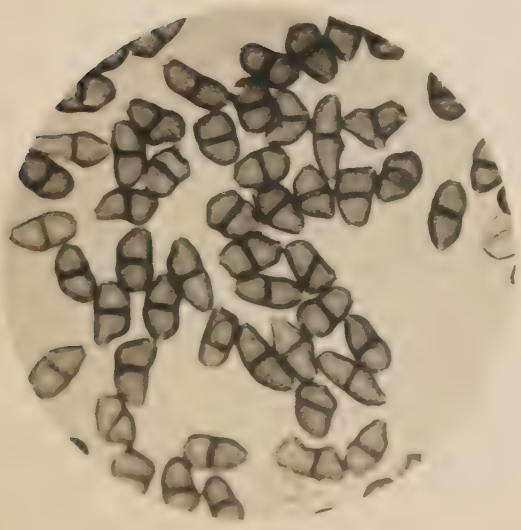


36b

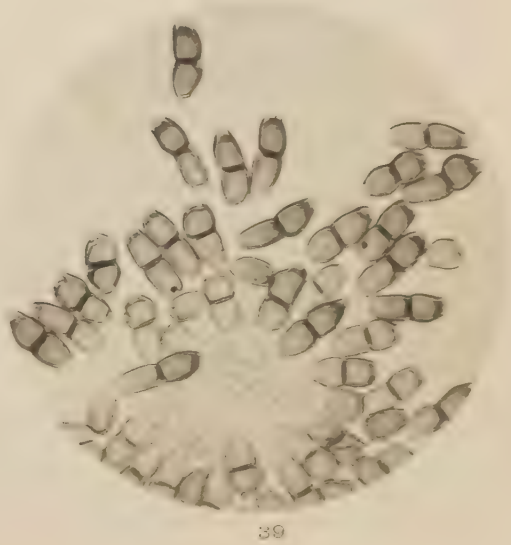
36c



37



38



39

PLATE 10

Smilax.

Teleutospores on Smilax glauca, Ohio, ×250.

AMARYLLIDACEAE.

Cooperia.

Teleutospores on Cooperia Drummondii, Texas, ×25[illegible].

Bomarea.

IRIDACEAE.

Iris.

On Iris Douglasii, [illegible].

ORCHIDACEAE.

Cypripedium.

Cypripedii Arth. & Holw. Teleutospores on Cypripedium hirsutum, Iowa, ×250.

Cypripedii Arth. & Holw. Uredospores on Cypripedium hirsutum, Iowa, ×250.

Unknown Orchid.

PLATE 10

Smilax.

40. Puccinia Smilacis Schw. Teleutospores on Smilax glauca, Ohio, ×250.

AMARYLLIDACEAE.

Cooperia.

41. Puccinia Cooperiae Long. Teleutospores on Cooperia Drummondii, Texas, ×250.

Bomarea.

42. Puccinia Bomareae P. Henn. Teleutospores on Bomarea ovata, Mexico, ×250.

IRIDACEAE.

Iris.

43. Puccinia Iridis (DC) Wallr. On Iris Douglasii, Calif., ×250.

ORCHIDACEAE.

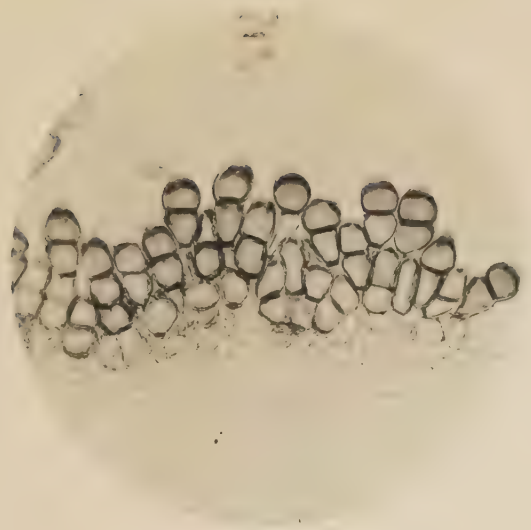
Cypripedium.

44a. Puccinia Cypripedii Arth. & Holw. Teleutospores on Cypripedium hirsutum, Iowa, ×250.

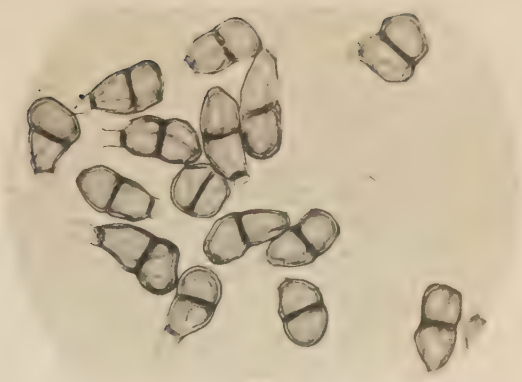
44b. Puccinia Cypripedii Arth. & Holw. Uredospores on Cypripedium hirsutum, Iowa, ×250.

Unknown Orchid.

45. Puccinia cinnamomea Diet. & Holw. Teleutospores on orchid, Mexico, ×250.

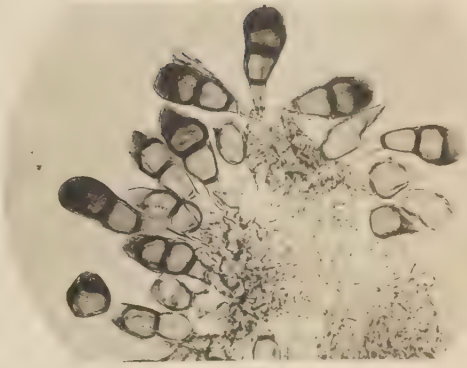


40

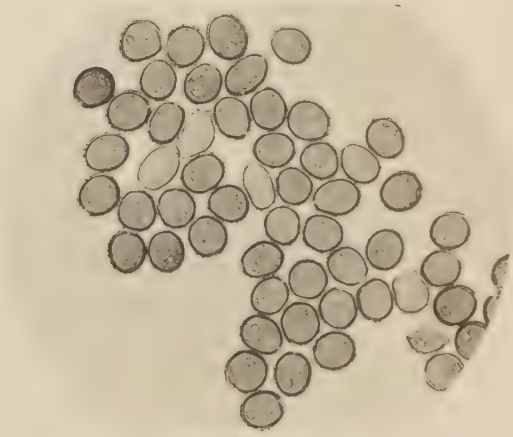


41

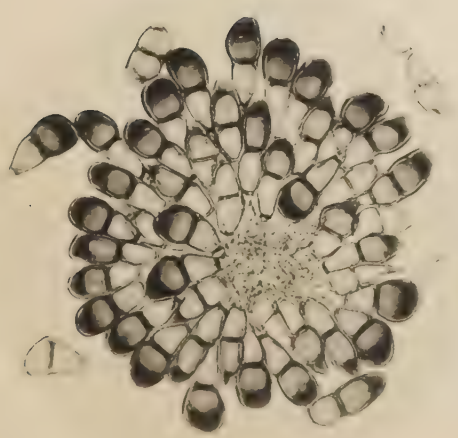
42



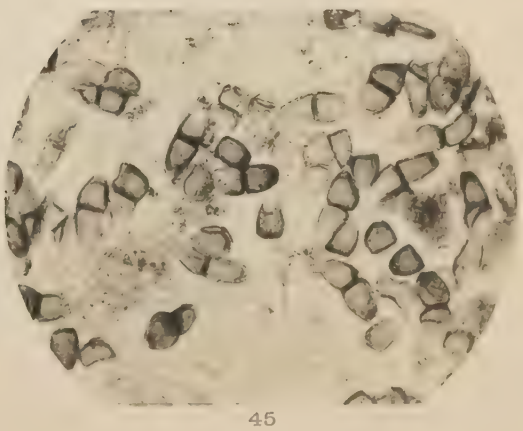
43



44b



44a



45

North American Uredineae

E. W. D. Holway

Vol. I. Part II.

Genus Puccinia.

Moraceae, Santalaceae, Aristolochiaceae, Polygonaceae, Amarantaceae, Portulaceaceae, Caryophyllaceae, Cruciferae; Saxifragaceae, Crassulaceae, Rosaceae.

Minneapolis, Minnesota
Issued May 15, 1906

MORACEAE.

FICUS (?).

46. Puccinia sepulta B. & C.

Proc. Am. Acad. Sc. **4**:126. 1860.

III. Spots orbicular, brown, up to 10mm. in diameter; teleutosori pulverulent hypophyllous, black, minute, thickly clustered in circular groups; teleutospores brown, smooth, elliptical to oblong, rounded at both ends or the lower cell narrowed to the base, apex not at all thickened or up to 6μ, variable in size, 24—48×16—24μ; pedicel brown, persistent, up to 40μ long.

Photo: No. 46.

The host is doubtful. Mr. Ricker kindly made careful comparisons at the National Herbarium for me and writes that it is safe to say that the host is not a Ficus. He thinks it is Eupatorium macrophyllum. The leaves, however, differ somewhat from Cuban specimens of that plant.

SANTALACEAE.

COMMANDRA.

47. Puccinia Comandrae Peck.

Bull. Torr. Bot. Cl. **11**:49. 1884.

III. Spots yellow or purple; teleutosori numerous, round, black, amphigenous, firm, punctiform to 1mm. in diameter, often in round groups and more or less circinnate, sometimes irregular and occupying large areas of the leaf and covering the stems for many mm., surrounded by the ruptured epidermis; teleutospores smooth, elliptical to oblong, apex rounded or conically pointed, up to 8μ thick, slightly constricted at the septum, lower cell mostly rounded, sometimes narrowed to the base, 32—52×16—22μ; pedicel hyaline or slightly tinted, up to 100μ long.

On Comandra pallida A. DC. Comandra umbellata (L.) Nutt., Calif., Utah., Nev., Mich., Canada.

Exsic: Ellis & Everh. Columb. *1957*. Garrett Fg. Utah *17*. Sydow Ured. *821*.
Photo: No. 47. On Comandra pallida. Utah.
The type is on Comandra pallida, from Washington.

ARISTOLOCHIACEAE.

ASARUM.

48. Puccinia asarina Kze.

Kunze & Schmidt, Mykol. Heft **1**:70. 1817.

Syn: Puccinia Asari Link. Linn. Sp. Pl. 6^2:68. 1825.

III. Spots yellow; sori brown, amphigenous, in orbicular groups 2-6mm. in diameter or surrounding the stems for many mm., often confluent, long covered by the epidermis, finally pulverulent; teleutospores yellowish-brown, smooth, elliptical to oblong, apex lighter colored, rounded or obtusely pointed, up to 8μ thick, often with a hyaline papilla over the germ-pore of the lower cell, which is mostly rounded, slightly constricted at the septum, 28—40×16—24μ; pedicel hyaline, fragile, up to 60μ long.

On Asarum caudatum Lindl., A. Lemmoni Wats., A. majus (Ducharte) Heller., Calif., Wash.

Exsic: Sydow Ured. *1060.*
Photo: No. 48. From Asarum caudatum. Wash.

POLYGONACEAE.

RUMEX.

49. Puccinia ornata Arth. & Holw.

Geol. & Nat. Hist. Surv. Minn. Bull. **3**:30. 1887.

III. Sori hypophyllous on bright reddish-purple spots, which become brown with age, pulvinate, firm, in somewhat round, circinnate clusters 2-10mm. in diameter, the central sorus larger, confluent, grey with the sporida of the germinating teleutospores, chocolate-brown; teleutospores smooth, yellowish-brown, oblong, constricted at the septum, apex mostly rounded, rarely subacute, not at all or a little thickened, lower cell mostly rounded, 36—52×16—24μ; pedicel 6-8μ wide and up to 110μ long, hyaline, persistent.

On Rumex Brittanica L. Minn. N. H.

Exsic: Seym. & E. Econ. Fg. *379.*
Photo: No. 49. Type specimen, from Vermillion Lake, Minn.
See note under Puccinia Parkerae, on Ribes.

50. Puccinia punctiformis Diet. & Holw.

Erythea **2**:128. 1894.

Sori amphigenous, scattered, punctiform to ½mm. in diameter, round, surrounded by the ruptured epidermis.

II. Uredosori light brown, pulverulent; uredospores globose, ovate, or elliptical, pale yellowish-brown, thin-walled, minutely echinulate, 28—40×20—26μ; germ-pores 4, equatorial.

III. Teleutosori black, firm; teleutospores brown, smooth, oblong, constricted at the septum, apex darker, rounded, 4-8μ thick, lower cell mostly narrowed to the base, 34—48×20—28μ; pedicel persistent, brown, half the length of the spore or shorter.

On Rumex salicifolius Weinm. (type.) R. hymenosepalus Wats., Calif., R. Mexicanus Meissn., Mex.

Photo: No. 50a. Uredospores from the type.
No. 50b. Teleutospores from the type.

This is a common species in Mexico, where the teleutospores are produced in abundance, while they are rare in Calif.

51. Puccinia Acetosae (Schum.) Koern.

Hedw. **15**:184. 1876.

Syn: Uredo Acetosae Schum. Enum. Pl. Saell **2**:231. 1803.
Puccinia Rumicis Lasch. *Rabh. Fg. eur. *496.*

Sori amphigenous, round punctiform to 3-4mm. in diameter, scattered, pulverulent.

II. Uredosori reddish-brown; uredospores brown, globose, ovate or elliptical, rather coarsely echinulate, germ-pores 2, at the apex of the spore.

III Teleutosori brown; teleutospores yellowish-brown, wall thick, epispore with minute, rather distant tubercles, which are more prominent on the upper cell, elliptical to oblong, slightly constricted at the septum, mostly with both cells rounded, rarely with the lower cell narrowed to the base, apex and germ-pore of the lower cell with broad low papillae, 30—40×18—24μ; pedicel hyaline, very fragile, up to 35μ long.

On Rumex hastatulus Baldw., Fla.

Photo: No. 51a. Uredospores from the Florida specimen.
No. 51b. Uredospores and teleutospores from Rumex arifolious All. Germany.

No American specimens of teleutospores have been seen, and they seem to rarely occur in Europe. P. Magnus, Abhl. Bot. Ver. Brandenburg **27**:18, 1885, says: "So giebt es viele offenbar heteröcishe Arten, die bei uns nur seltener zur Teleutosporenbildung gelangen und gewöhnlich

durch Uredosporen ueberwintern, wie z. B. Puccinia Acetosae (Schum.) auf Rumex Acetosa, u. s. w. * * *. Bei der meisten dieser Fälle scheint es recht klar zu sein wie an Stelle des unterbleibeden Generations-wechsels die Ueberwinterung durch die Uredo-Fruchtform zur Erhaltung der Art eintritt."

According to Fisher, the uredospores sometimes have 3 germ-pores.

OXYRIA.

52. Puccinia Oxyriae Fckl.

Jahrb. Nassauischen Ver Naturk. **29**:14. 1875.

Syn: Puccinia Oxyriae Buch. White. Grev. **11**:15. 1882.
Puccinia Buchani De Toni. Sacc. Syll. **7**:723. 1888.

Sori on purplish spots, minute, amphigenous, mostly hypophyllous, scattered or in circular clusters, often confluent, surrounded by the ruptured epidermis, pulverulent.

II. Uredosori light cinnamon-brown; uredospores yellowish-brown, ovate to globose, minutely echinulate, 24—36×22—28μ; germ-pores 5.

III. Teleutosori chestnut-brown; teleutospores brown, the lower cell nearly smooth, the upper cell with irregular lines which form quite prominent ridges at the apex, oblong-elliptical to oblong, apex rounded, with a broad cap-like papilla, often a similar papilla over the germ-pore of the lower cell, which is rounded, or longer and narrowed to the base, wall 4-5μ thick, constricted at the septum, 32—48×16—24μ; pedicel hyaline, very fragile, the length of the spore and shorter.

On Oxyria digyna (L.) Camptd., Col., Utah, Calif., Canada.

Photo: No. 52a. Uredospores, specimen from Col.
No. 52b. Teleutospores. Same.

The Cat. Sc. Papers gives the date of the paper describing this species as 1876-7. The separate, with the title Symbolae Mycologicae, Dritter Nachtrag, and apparently with the same paging, is dated 1875.

POLYGONUM.

53. Puccinia Bistortae (Str.) DC.

Fl. Fr. **6**:61. 1815.

Syn: Uredo Polygoni Bistortae Str. Wetter. Ann. **2**:103. 1810.
Puccinia Bistortae Mart. Prod. Fl. Mosq. :226. 1817. (2nd. Ed.)
Uredo pteridiformis Funk. *Crypt Gewächse **27**:4. 1819.
Puccinia Polygonorum Duby. Bot. Gall. **2**:889. 1830.
Puccinia Polygonorum vivipari Dietr. *Dorpat. Arch. Naturk. :268. 1859.
Puccinia Polygoni vivipari Karst. Finlands Natur och Folk :33. 1879.
Puccinia Polygoni vivipari Detr. Karst. Helsingf. Faun. Fl. Fenn. **8**:221. 1882.
Puccinia uniformis Pammel & Hume. Proc. Dav. Acad. Sc **7**:250. 1899.

Sori amphigenous, but mostly hypophyllous, scattered, minute, round, pulverulent, often confluent.

II. Uredosori ocherous; uredospores yellowish, globose or elliptical, minutely verrucose, wall about 3μ thick, 20—28×20—26μ; germ-pores minute, inconspicuous, (4-6?) subequatorial.

III. Teleutosori dark brown; teleutospores brown, elliptical to oblong, slightly verrucose, the tubercles arranged in a few irregular or longitudinal lines, rounded at each end, the cells of nearly the same shape and size, apex not thickened, not at all or slightly constricted at the septum, 20—28×16—24μ in some specimens, in others 24—36×16—26μ; pedicel hyaline, short, fragile.

On Polygonum bistortoides Pursh. P. linearifolium (Wats.) Small. P. Davisiae, Brewer., Col., Wash., Idaho, Ariz., Calif., Wyo., N. H.

Exsic: Ellis & Everh. N. A. F. *3568*. Sydow Ured. *1814*. Nelson Pls. Wyo. *356*.

Photo: No. 53a. Uredospores from P. bistortoides Col.
No. 53b. Teleutospores from the same.
No. 53c. Teleutospores from the type specimen of Puccinia uniformis, no doubt the same host.

An examination of the type specimen of Puccinia uniformis showed that the host was not Rumex, but without doubt Polygonum. The "smooth" uredospores described by the authors do not occur.

Of the species formerly referred to Puccinia Bistortae in Europe. Puccinia mammillata Schroet. and Puccinia septentrionalis Juel. have been separated, and they seem to be good species. The former has two "form-species," Puccinia Mei-mammillata Semadeni and Puccinia Angelicae-mammillata Klebahn, with aecidia on Meum and Angelica.; the latter has its aecidium on Thalictrum alpinum (Aecidum Sommerfeltii). The remaining forms, which are like the American specimens, have been again divided into several forms, Puccinia Angelicae-Bistortae Kleb. (Syn. P. Cari-Bistortae Kleb.), with aecidia on Angelica and Carum; Puccinia Conopodii-Bistortae Kleb., with aecidium on Conopodium; Puccinia Polygoni-vivipari Karst., with aecidium on Angelica.

The cultures and observatons upon which these names are based have been made by Soppitt, Juel, Klebahn, Bubak, and Ed. Fisher.

As nothing is yet known of the aecidia connected with the American forms it seems best to leave them all under Puccinia Bistortae. We have specimens with the small spores characteristic of Puccinia Polygoni-vivipari, and no doubt our specimens, when cultures are made, will be separated into forms with aecidia on different Umbelliferae.

Karsten is given as authority for the name Puccinia Polygoni-vivipari. It was first used by Dietrich, but without description, in 1859. It was then described by Karsten as Puccinia Polygoni-vivipari Dietr. in Enum. Fung., 1882, although Karsten refers to it in his Mycol. Fenn., 1879, as Puccinia Polygoni-vivipari Karst. Enum. Fung. 33., a conflict of dates which I can account for only on the supposition that Enum. Fung. was isued as a separate some time in advance of its publication in Natur och Folk, a not unusual occurence.

54. Puccinia amphispilusa Diet. & Holw.

Erythea **3**:79. 1895.

Sori amphigenous, punctiform to 1mm. in diameter, scattered or circinnate around a large central sorus.

II. Uredosori cinnamon-brown; uredospores yellowish-brown, globose to elliptical, echinulate, 24—28×20—24μ; germ-pores 4, each covered with a small hyaline papilla, showing only when heated in lactic acid.

III. Teleutosori brown; teleutospores smooth, brown, elliptical or somewhat angular and irregular, slightly constricted at the septum, with a flat hyaline papilla over the apex and over the germ-pore of the lower cell, mostly rounded at both ends, 28—40×18—28μ; pedicels hyaline, very fragile, up to 60μ long.

On Polygonum sp., Calif.

Photo. No. 54a. Uredospores from the same.
No. 54b. Teleutospores from the same.
The teleutospores are larger, rather lighter in color, more irregular, and with less prominent germ-pores than those of Puccinia Bistortae.

55. Puccinia Polygoni-amphibii Pers.

Syn. Meth. Fung. :227. 1801.

Syn: Uredo Polygoni Schum. Enum. Pl. Saell. **2**:233. 1803.
Uredo Betae Convolvuli A. & S. Consp. :127. 1805.
Puccinia Polygoni A. & S. l. c. :132. 1805.
Puccinia Polygoni-Convolvuli Hedw. DC. Encyc. **8**:251. 1808.
Uredo Convolvuli Str. Wetter. Ann. **2**:96. 1810.
Uredo Polygoni Str. l. c. :103. p. p.
Puccinia Persicariae Mart. Prod. Fl. Mosq. :227. 1817. (2d Ed.)
Aecidium Geranii maculati Schw. Schrift. Nat. Ges. Leipzig :67. 1822
Puccinia Polygoni-Pennsylvanici Schw. l. c. :72.
Puccinia Polygonorum Schl. Fl. Ber. **2**:132. 1824.
Caeoma Polygonorum Link. Linn. Sp. Pl. **6**²:10. 1825. p. p.
Puccinia Polygonorum Link. l. c. :69.
Erysibe cinnamomea Polygonorum Wallr. Fl. Germ. **2**:207. 1833.
Erysibe cinnamomea Convolvuli Wallr l. c.
Trichobasis Polygonorum Berk. *Outl. 332. 1860.
Puccinia Polygonorum Fckl. Jahrb. Nass. Ver. Naturk. **23**:57. 1869.
Puccinia Lysimachiae Karst. Finlands Natur och Folk **31**:27. 1879.
Aecidium sanguinolentum Lindr. Bot. Not. :241. 1900.
Puccinia Polygoni Pers. aut.

O. I. Spots usually reddish or purple, often brilliant, spermogonia amphigenous, in the center of the groups of aecidia on the lower side of the leaf, and usually on the upper side directly opposite; aecidia more or less circinnate, the groups sometimes very thickly covering the leaf; peridia low, reflexed, much incised; peridial cells polygonal, irregularly angular, or nearly round, firmly united, membrane closely and evenly verrucose, 16—39×16—24μ; aecidiospores globose to polyangular, very minutely verrucose, 16–22μ in diameter.

II. Uredosori amphigenous, light brown at first, becoming cinnamon-brown, scattered or circinnate, round, pulverulent; uredospores yellowish-brown, globose, elliptical or obovate, echinulate, 18—28×16—22μ, on rather long

hyaline pedicels which persist after the spores have fallen and appear between the teleutospores which follow in the same sorus; germ-pores 2, mostly at the apex of the spore.

III. Teleutospores partly in the uredosori, in which case the apex is mostly regularly rounded, and the sori amphigenous and scattered, and partly in separate hypophyllous sori which are smaller, partially buried in the leaf tissue, long covered by the epidermis, dark brown, often with a large uredosorus in the center, frequently occupying the entire leaf, the apex of the spores in these sori often truncate, obliquely or variously angled, all teleutospores smooth, chestnut-brown, oblong-clavate, slightly constricted at the septum, apex 4–12μ, thick, lower cell narrowed to the base, 32—50×14—22μ; pedicel hyaline or slightly tinted next the spore, persistent, the length of the spore and shorter.

On Polygonum Convolvuli L., P. scandens L. P. hirsutum Walt., P. emersum (Mx.) Britton, P. Pennsylvanicum L., P lapathifolium nodosum Small., P. hydropiperoides Mx., P. Hartwrightia Gray, P. Virginiana L. II. III. Throughout the U. S. and in Mex. I. Specimens seen from Ill., Ia., Penn., Minn., Canada. On Geranium maculatum L.

Exsic: Ellis N. A. F. *221. 259. 1455. 1859.* Griffiths West Am. Fg. *15.* Ellis & E. Fg. Columb. *1862.* Seym. & E. Econ. Fg. *371. 373. 374.* Rabh.-Wint. Fg. eur. *4130.* Kellerm. Ohio Fg. *92. 93. 115. 175.* Nelson Pls. Wyo. *8661.* Baker Pac. Slope Fg. *1571.* Pls. W. C. Col. *934.* Sydow Ured. *1732.*

Photo: No. 55a. Uredospores on Polygonum Convolvulus, Ohio.
No. 55b. Teleutospores on Polygonum emersum, Mass.

Tranzschel made cultures of this species, using teleutospores from Polygonum amphibium, and obtained the aecidium on Geranium palustre. This has been verified by Bubak, who grew the aecidium on Geranium pratense and G. sylvaticum, and by Klebahn, who obtained aecidia on Geranium affine, G. pratense, G. palustre, G. nodosum, G. phaeum, and G. molle. Arthur, using aecidiospores from Geranium maculatum, produced uredo and teleutospores on Polygonum emersum.

The form on Polygonum Convolvulus and P. scandens has the uredosori very abundant and often confluent in large groups. The teleutosori are tardily formed, hypophyllous, black, early naked, and they do not occur in the numerous, minute, covered sori of the form on the other hosts. Tranzschel was unable to infect Polygonum Convolvulus with uredospores from Polygonum amphibium, and separated the form on the former host as Puccinia Polygoni A. & S., an older name than Puccinia Polygoni-Convolvuli, which is sometimes used. He obtained the aecidial form on Geranium pusillum with teleutospores from Polygonum Convolvulus, and by using these aecidiospores grew the uredospores and teleutospores. The Aecidium differs from Aecidium sanguinolentum only in having pale green spots instead of red ones.

The uredospores are the same in both forms and the teleutospores differ from those in the uredosori of P. Polygoni-amphibii only in having pedicels which are apparently always colored. The few specimens seen might seem to warrant its separation, but Sydow says: "Diese Unterschiede in der Beschaffenheit der Sori treten jedoch nur bei den europäischen Nährpflanzen der Art deutlicher hervor. Die ausser-europäischen Formen lassen eine solche strenge Scheidung durchaus nicht zu. Bei diesen finden sich alle Übergänge von den einen zum andern Form. Es erscheint daher am Zweckmässigsten vorläufig nur eine Art anzuerkennen bis eingehende Kulturversuche hierüber vorliegen."

56. Puccinia septentrionalis Juel.?

*Ofvers. af. K. Vet. Akd. Förh. :383. 1895.

Syn: Caeoma Thalictri Sommf. Suppl. Fl. Lapp. :230. 1826.
Aecidium Sommerfeltii Johans. *Ofvers K. Vet. Akad. Förh. :161. 1884.

Sori hypophyllous, small, round, soon naked, pulverulent.

II. Uredosori light brown; uredospores yellowish-brown, globose, elliptical, or ovate, membrane thin, with rather distant short spines, 16—28×12—20μ germ-pores apparently 3–4, indistinct.

III. Teleutosori dark brown; teleutospores elliptical to oblong, yellowish-brown, smooth, or sometimes with the appearance of 2–4 longitudinal lines, both cells equal and rounded or oblong, or both narrowed from the septum, germ-pore of the lower cell close to the septum, that of the upper at the apex, both with prominent hyaline papillae, 28—44×12—20μ; pedicel short, hyaline, fragile.

On Polygonum scandens L. New Jersey.

Exsic: Seymour & Earle, Econ. Fg. *367*.
Photo: No. 56a.
No. 56b. x500 diameters.
No. 56c. x500 diameters. From Sydow Ured. 1381. On Polygonum viviparum. Sweden.

The specimens in this Exsiccatae are the only ones that have been seen. It seems quite unlikely that the New Jersey specimens can be connected with Aecidium Sommerfeltii, which is a Northern and high mountain aecidium on Thalictrum. The teleutospores do not differ in any way from the European specimens, as will be seen by an examination of the photographs. The uredospores, however, have much thinner walls, and are more often elliptical or ovate, instead of globose. It seems best not to give it a new name until more can be learned about it. The same appearance of longitudinal lines is seen in the European specimens.

AMARANTACEAE.

GUILLEMINEA.

57. Puccinia Guillemineae Diet. & Holw.

Bot. Gaz. **24**:34. 1897.

I. Aecidia epiphyllous, orange-red, scattered or closely crowded in round groups of 3–12, small, 240–300μ in diameter, peridia irregularly incised, not reflexed; aecidiospores globose to polygonal, with orange-red contents when fresh, minutely verrucose, wall irregularly thickened, 16—20μ in diameter.

II. Uredosori epiphyllous, round, punctiform to ¾mm. in diameter, scattered, rarely confluent, cinnamon-brown; uredospores yellowish-brown, closely

and evenly verrucose, globose, 18–24μ in diameter, with an occasional spore up to 28μ; germ-pores 4, equatorial.

III. Teleutosori as the uredosori, but black; teleutospores smooth, deep chestnut brown, elliptical, rounded at both ends, apex 4—7μ thick, seldom constricted at the septum, 26—36×20—24μ; pedicel slender, subpersistent, up to 80μ long.

On Guilleminea illecebroides H.B.K. Mexico.

Photo: No. 57a. Uredospores from Guadalajara specimen.
57b. Teleutospores from the same.

IRESINE.

58. Puccinia macropoda Speg.

Anales Soc. cient. Arg. **9**:—(13). 1880.

Syn: Uredo striolata Speg. l. c. 173. 1880.

II. Uredosori amphigenous on yellow spots, scattered, or subcircinnate with the central sori confluent, long covered by the epidermis, finally pulverulent, light brown; uredospores yellowish-brown, globose or subglobose, finely rugose-striate, 22–30μ in diameter.

III. Teleutosori amphigenous, often epiphyllous and on the stems, compact, suborbicular or elongated, 1–4mm. long, black; teleutospores elliptical-ovate, rounded at both ends, constricted at the septum, opaque brown, apex thickened, 60×30μ; pedicel hyaline, narrowed to the base, 8–10μ wide and 100μ long.

On Iresine sp. Cuba. Photo: No. 58a. Uredospores ×250. 58b. Uredospores ×500.

No teleutospores have been seen. The description is from Spegazzini.

PORTULACACEAE.

CLAYTONIA. MONTIA.

59. Puccinia claytoniata (Schw.) Syd.

Monogr. Ured. **1**:561. 1903.

Syn: Caeoma (aecidium) claytoniatum Schw. Am. Phil. Soc. **4**:294. 1834.
Puccinia Mariae-Wilsoni Clinton. Rep. N. Y. State Mus. **25**:115. 1873.

O. I. Spermogonia yellowish-brown, sparingly developed, scattered among the aecidia, which are mostly hypophyllous and on the stems, often covering the entire plants, low, broad, margin incised, little reflexed; aecidiospores orange, subglobose, polygonal or oblong, minutely verrucose, 16—24×14—20μ. Spots none, or in Montia with large irregular yellowish spots.

III. Teleutosori cinnamon-brown, small, scattered, or in large irregular groups, surrounded by the ruptured epidermis, soon pulverulent; teleutospores brown, minutely verrucose, elliptical to oblong, sometimes angular and irregular, variable in size, mostly rounded at both ends, apex not thickened but sometimes with a hyaline papilla, 28—48×16—28μ; pedicel hyaline, fragile, short.

On Claytonia Caroliniana Mx. C. Virginiana L., C. megarrhiza (A. Gray) Parry., Montia asarifolia (Bong.) Howell. M. sibirica (L.) Howell. Ia., Ohio, Vt., Wash., Ky., Ill., Wisc., N. Y., Penna., Minn., Col., Utah.

Exsic: Baker. Pls. S. Col. *1045*. Ellis N. A. F. *1027*. *1017*. Rabh. Fg. eur. *2909*. Vestergren Microm. rar. sel. *647*. Kellerm. Ohio Fg. *12*. *72*. Sydow Ured. *323*. *1315*. *1316*. Seym. & E. Econ. Fg. *B27*. Roum. Fg. Gall. *3414*.

Photo: No. 59. Teleutospores from Claytonia Virginica. Ohio.

Aecidia have been seen only on Claytonia Virginica and C. Caroliniana.

CARYOPHYLLACEAE.

STELLARIA. CERASTIUM. DIANTHUS. SPERGULA.

60. Puccinia Arenariae (Schum.) Wint.

Rabh. Krypt. Fl. **1**:169. 1884.

Syn: Uredo Arenariae Schum. Enum. Pl. Saell. **2**:232. 1803.
Uredo Alsines Schum. l. c.
Puccinia Dianthi DC. Fl. franc. **2**:220. 1805.
Uredo verrucosa Str. Wetter. Ann. **2**:107. 1810.
Puccinia Lychnidis DC. Fl. franc. **6**:57. 1815.
P. Spergula Arenariae serpyllifoliae DC. l. c. 55.
P. crassa Lk. *Mag. Ges. Naturf. Freunde. Berlin. **8**:30. 1816.
P. Lychnidiarum Lk. *l. c. :29. p. p.
Dicaeoma verrucosum Mart. Fl. Erlang. :321. 1817.
Puccinia verrucosa Schl. Fl. Ber. **2**:132. 1824.
Caeoma Arenariae Lk. Linn. Sp. Pl. **6**^{2}:27. 1825.
Puccinia Saginae Duby. Bot. Gall. **2**:887. 1830.
P. Stellariae Duby. l. c.
Caeoma verrucosum Nees. Syst. :9. 1837.
Uredo Lychnidiarum Desm. Ann. Sc. Nat. **17**:94. 1842.
Puccinia Malachi Kirchn. *Lotus :181. 1856.
P. Sagina Kirchn. *l. c.
P. fasciata Bon. Abhl. Nat. Ges. Halle **5**:218. 1860. p. p.
P. denticulata Otth. *Bern. Mitth. :69. 1868.
P. circinans Fckl. Jahrb. Nass. Ver. Naturk. **23**:53. 1869.
P. Agrostemmae Fckl. l. c. :50.
P. Stellariae Fckl. l. c. :50.
P. Moeringiae Fckl. l. c. :51.
P. caudata Barclay. Jour. Asiatic Soc. Bengal. :219. 1891.

III. Teleutosori hypophyllous, brown, at first covered by the epidermis, soon pulverulent, scattered, or often confluent and surrounding the stems for many mm., or forming long sori on the leaves which are more or less twisted and distorted, often grey with the sporidia of the germinating

teleutospores, which are oblong to oblong-clavate, yellowish-brown, smooth, apex rounded or acute, variously thickened, up to 10μ, somewhat constricted, lower cell mostly narrowed to the base, 32—56×12—20μ; pedicel persistent, hyaline, up to 120μ long.

On Stellaria longipes Goldie., S. longipes laeta Wats., S. longipes Edwardsii Wats., S. borealis Bigel., Dianthus barbatus L. Spergula arvensis L. Cerastium arvense, Alaska, Labrador, Mont., Penn., N. Y.

Exsic: Ellis N. A. F. *1457*. Seymour & Earle Econ. Fg. *263*.
Photo: No. 60a. On Stellaria longipes. Alaska.
60b. On Spergula arvensis. N. Y.
60c. On Dianthus barbatus. Penn.

ARENARIA.

61. Puccinia hysteriiformis Peck.

Bot. Gaz. **6**:276. 1881.

III. Teleutosori firm, black, elongated, 2–10mm. in length, for sometime covered by the epidermis which splits longitudinally and remains surrounding them; teleutospores bright yellowish-brown, smooth, apex rounded or obtusely pointed, slightly thickened, or up to 8μ thick, constricted at the septum, lower cell mostly rounded, 28—44×16—20μ; pedicel persistent, hyaline or slightly tinted next the spore, slender, up to 70μ long.

On Arenaria Uintahensis A Nels. A. verna L. A Fendleri Gray. Utah.

Exsic: Ellis & Everh. Fg. Columb. *1963*. Garrett Fg. Utah 14. Sydow Ured. *1928*.
Photo: No. 61. From Arenaria Uintahensis. Utah.

The teleutospores of the different specimens vary in the thickness of the walls. The type specimen is on Arenaria verna, Utah.

Puccinia obliqua B & C.

Jour. Linn. Soc. **10**:356. 1869.

Said to be on the leaves of some plant resembling Chick-weed. Appears to be Puccinia lateritia B. & C. on some one of the Rubiaceae.

62. Puccinia modica Holway.

Jour. Mycol. **10**:164. 1904.

II. Uredosori amphigenous, round or elongated, ½–1mm. in diameter, cinnamon-brown; uredospores globose, very finely and evenly verrucose, yellowish-brown, 20—24μ in diameter, germ-pores 4–5, scattered.

III. Teleutosori like the uredo, but black; teleutospores deep brown, smooth, broadly elliptical, rounded at both ends, wall up to 4μ thick, apex 4—8μ

thick, the two cells of the same size, very uniform in size, 36—40×24—32μ; pedicel persistent, hyaline, up to 120μ long.

On Arenaria reptans Hemsl., A. Peyritshii Rohrb. Arenaria sp. Mexico.

Photo: No. 62. On Arenaria sp. Etla, Oaxaca. Mex.

CRUCIFERAE.

ARABIS. ERYSIMUM. CHEIRANTHUS. DRABA. SISYMBRIUM.

63. Puccinia Holboellii (Hornem.) Rostr.

Middelser om Groenland **3**:534. 1888.

Syn: Aecidium Holboellii Hornemann. Fl Dan. **37**:11. 1840.
Puccinia Barbareae Cooke. Grev. **8**:34. 1879.
Puccinia Cheiranthi E. & E. Bot. Gaz. **10**:366. 1885.
Puccinia consimilis E. & E. Jour. Mycol., **6**:120. 1891.
Puccinia palefaciens Diet. et Holw. Erythea **2**:128. 1894.

III. Teleutosori round, mostly hypophyllous, usually covering the leaf closely, scattered on the upper surface, at first brown, becoming darker with age, often germinating on the plant and then grey with the sporidia; teleutospores variable, rarely elliptical, mostly oblong to oblong clavate, often with a few one-celled spores, and irregular and very large two-celled spores, brown, apex mostly rounded, occasionally acute, from scarcely thickened up to 8μ, slightly constricted, lower cell narrowed to the base, 32—60×14—24μ, pedicel hyaline persistent, up to 100μ long.

On Arabis arcuata Gray. A. Holboellii Hornem., A. Drummondii Gray. A. Lyallii Wats., A. perennans Wats., A. furcata Wats. (or Suksdorfii Howell), A. ambigua intermedia DC. Erysimum asperum Arkansanum Gray., E. cheiranthoides L., Cheiranthus pygmaeus Adams. Draba speciosa Greene. Sisymbrium linifolium Nutt. Utah., Mont., Ore., Wash., Calif., Alaska.

Exsic: Ellis N. A. F. *1834. 2891. 2889.*
Garrett. Fg. Utah *4.* Arth. & Holw. Ured. *17.*
Sydow Ured. *1926.* Baker. Earle & Tr. Pls So. Col. *1050.*

Photo: No. 63a. On Arabis Holboellii. Calif.
63b. Same, different sorus.
63c. On Erysimum hieracifolium, Finland, E. Warming.
63d. On Cheiranthus pygmaeus, type specimen of Puccinia Cheiranthi E. & E.
63e. On Arabis Holboellii, Utah. Germinating teleutospores.
63f. On ? Type specimen of Puccinia Barbareae Cke.
63g. On Arabis Holboellii. Type specimen of Puccinia palefaciens.
63h. On Arabis perennans. Calif. Puccinia palefaciens.
63i. On Sisymbrium linifolium. Type coll. of Puccinia consimilis E. & E.
63j. On Draba speciosa.

The specimens placed here provisionally agree in having sori thickly covering the leaves, in the spores varying greatly in shape and size, and in their germinating on the living plant. I do not think any posess an aecidial stage. Puccinia Holboellii collected by Parish (Erythea 2:129) has on some of the specimens teleutosori between the aecidia, but I regard this as an accidental association. Puccinia Barbareae Cke. is described as being associated with an aecidium, but the portion of the type examined has spermogonia and teleutospores and it differs in no way from Puccinia palefaciens. Should the latter prove to be a good species, it will have to be known by Cooke's name.

All specimens of Puccinia consimilis that I have examined have had the aecidia on separate plants, and although the aecidia have often been collected since, there have been no teleutospores with them. Mr. Garrett, from field observations, thinks the aecidium on Arabis Holboellii is connected with a grass rust.

From an examination of a large number of specimens of Puccinia palefaciens collected at one time, I find that spermogonia occur on part of the plants only. The color of the sori and the condition of the leaf varies greatly with the age of the specimen. Two forms of spores are shown from the same specimen of Puccinia Holboellii in photographs 63a and 63b. Another could have been made differing in no way from 63h, having the same large teleutospores in connection with the more numerous oblong ones.

At present I see no way in which these different forms can be separated.

A peculiar specimen was collected by Mr. Parish on Arabis Holboellii in Calif., the sori being very light brown, the spores mostly germinating at once, with all the spores entirely hyaline, but as their size and shape is the same as the other specimens, it is left here, although further collections may show it to be distinct

Rostrup states in his description that Aecidium Holboellii was described in 1836, but Fascicle 37 of the Flora danicae was not issued according to the title page until 1840.

DRABA.

64. Puccinia Drabae Rudolphi.

Linnaea **4**:115. 1829

Syn: Puccinia Drabae Hazsl. *Magyarhon üszökgombai es ragyai :148. 1876.
Puccinia ambiens Rostr. Bot. Tidsk. **11**:74. 1879.
Puccinia Hazslinskyi De Toni. Sacc. Syll **7**:692. 1888.
Puccinia Drabae artica P. Henn. Bibl. Bot. **42**:41. 1897. (Pilze aus der Umanakdistikt.)

III. Teleutosori elliptical to linear, mostly on the stems and pedicels, brown, long covered by the epidermis, often confluent and surrounding the stems, pulverulent, ruptured epidermis prominent; teleutospores yellowish-brown, elliptical to oblong, strongly constricted, mostly rounded at both ends, wall quite evenly 3μ thick, the two cells nearly the same size and shape, rather strongly tuberculate, 24—36×14—16μ; pedicel short, hyaline, fragile.

On Draba arabisans Michx., Bonaventure and Rimouski Counties, Quebec, Canada.

Photo: No. 64.

Uredospores are described by Hennings for his var. artica, but as he says: "episporio verrucoso" they are no doubt cells of teleutospores which have separated. The walls of the spores in European specimens are often 4—5μ thick, but otherwise our specimens do not differ from them.

ARABIS.—SMELOWSKIA.

65. Puccinia aberrans Peck.

Bot. Gaz. **4**:217. 1879.

III. Teleutosori amphigenous, pulverulent, minute, thickly covering the under side of the leaves and soon confluent, scattered on the upper surface, dark brown; teleutospores yellowish-brown, oblong-elliptical to oblong, apex mostly rounded, rarely truncate or obtusely pointed, about 8μ thick, epispore covered with a net-work of fine lines only visible when dry, 36—48×20—28μ; pedicel hyaline, fragile, the length of the spore and shorter.

On Smelowskia Americana Ryd., Col., Utah. On Arabis sp. Nev.

Exsic: Rabh.-Wint. Fg. eur. *3505*.
Photo: No. 65. Type collection, Utah, on Smelowskia.

In some specimens the teleutospores are 3—4 celled and various irregular forms, as well as very small and very large ones occur. The specimen on Arabis was collected by M. E. Jones in 1882 and the host appears to be correctly named.

THLASPI.

66. Puccinia Thlaspeos Schubert.

*Fl. Dresden. **2**:254. 1823.

Syn: Puccinia Thlaspeos Duby. Bot. Gall. **2**:887. 1830.
Puccinia Thlaspidis Vuill. Bull. Soc. Bot. Fr. **32**:184. 1885.
Puccinia Vuilleminii De Toni. Sacc. Syll. **7**:692. 1887.

III. Teleutosori light chestnut-brown, covering the entire under side of the leaves, scattered on the upper surface, small, round, not confluent; teleutospores often germinating in the sorus, pale yellowish-brown, smooth, oblong to subclavate, apex rounded or obtusely pointed, more or less thickened (up to 8μ), lower cell mostly narrowed to the base, slightly constricted at the septum, 34—44×14—18μ, pedicel persistent, hyaline, up to 60μ long.

On Thlaspi glaucum Nelson, Utah. (Garrett.)

Photo: No. 66.

The attacked plants grow more slender and do not fruit. The mycelium is said to be perennial.

67. Puccinia Utahensis Garrett. n. sp.

III. Teleutosori amphigenous scattered, chestnut-brown, round, about 1mm. in diameter, at first covered by the epidermis, soon naked and pulverulent; teleutospores brown, ellipsoidal to oblong, often somewhat angular, wall uniformly 2½mm. thick, strongly constricted at the septum, the cells elliptical and of the same size, or, more rarely, the upper larger and the lower

narrowed to the pedicel, the epispore covered rather closely with irregular tubercles arranged in longitudinal rows and often united into lines, apex with a broad, light colored papilla, 30—44×16—20μ; pedicel fragile, hyaline, short.

On Thlaspi glaucum Nelson, Utah.

Photo: No. 67. From the type specimen.

The teleutospores are the same shape and size of those of **Puccinia Crucifearum**, which has yellow teleutospores with very faint markings, consisting of small tubercles evenly and closely covering the epispore, especially on the upper cell, the lower sometimes being nearly smooth. In this collection only a few sori occurred on a plant.

Puccinia Purpusii P. Henn.

Hedw. **37**:270. 1898.

This was collected in California and said to be on Arabis. I have seen the type specimen and it is Puccinia plumbaria Peck, on Phlox or some genus near it. It is the Western form of P. plumbaria with strongly verrucose teleutospores.

Puccinia arabicola E. & E.

Jour. Mycol. **6**:119. 1891.

The type specimen of this is but a fragment of a leaf, but the fungus is Puccinia plumbaria Peck, differing in no way from the form on Phlox divaricata, occuring in Ill. and Iowa. The host is certainly Phlox and not Arabis.

SAXIFRAGACEAE.

SAXIFRAGA. HEUCHERA. MITELLA.

68. Puccinia curtipes Howe.

Bull. Torr. Bot. Cl. **5**:3. 1874.

Syn: Puccinia striata Cke. Grev. **7**:3. 1878.
Puccinia Saxifragae curtipes Diet. Ber. Deutsch. Bot. Ges. **9**:40. 1891

III. Spots none, or, in some specimens, purple, in others, yellow; teleutosori amphigenous, mostly hypophyllous, small, round, often confluent in irregular groups, elongated on the petioles and veins, pulverulent, chestnut-brown; teleutospores brown, elliptical to oblong, occasionally a little constricted at the septum, strongly striate, apex with a small conical papilla, 24—36×16—20μ; pedicel the length of the spore and shorter, hyaline, fragile.

On Saxifraga nivalis L., S. integrifolia Hook., S. Pennsylvanica L., S. Virginiensis Michx., Heuchera hispida pursh., H. parvifolia Nutt. H. cylin-

drica Dougl. H. Americana L. H. glabella T. and G. H. ovalifolia Nutt. H. rubescens Torr., Mitella trifida Graham, Mitella stauropetala Piper. Calif., Neb., S. Dak., Col., Mont., Wisc., Wash., Utah, Ill., W. Va., Penn., Ohio, Canada.

Exsic: Griffiths West Am. Fg. *272*. Ellis N. A. F. *2242. 1034. 1465*. Fg. Columb. *1379. 1575*. Arth. & Holw. Ured. Exsic. *7*. Rabh.-Wint. Fg. eur. *3817*. Roumeg. Fg. sel. *4315*. Sydow Ured. *1320. 1016*.

Photo: No. 68a. From Heuchera ovalifolia, Canada.
68b. The same x500.

The teleutospores rarely germinate in the sorus. This differs from Puccinia Heucherae in its wider and shorter spores, which are not thickened at the apex; the striations are also much stronger. The teleutospores vary in size in the different specimens, in one being quite uniformly $28\times20\mu$.

SAXIFRAGA.

69. Puccinia Chrysoplenii Grev.

Hook. Eng. Fl. 5^2:367. 1836.

III. Teleutosori mostly hypophyllous, firm, light brown, pulvinate, the leaf deeply depressed opposite, scattered or in small groups, soon confluent; teleutospores pale yellow, almost hyaline, oblong, narrowed to both ends, not constricted, apex rounded or obtusely pointed, 4–6μ thick, 28—44×12—16μ; pedicel persistent, hyaline, up to 50μ long.

On Saxifraga punctata L. Colorado.

Exsic: Ellis N. A. F. *2233*.
Photo: No. 69.

Dr. Dietel has described two forms, *peristens* and *fragilipes*. Only the former occurred in the three specimens examined. Ours do not seem to differ in any way from European specimens on Chrysoplenium.

70. Puccinia Laurentiana Trel.

Harriman, Alaska Exped. **5**:38. 1904.

III. Teleutosori hypophyllous, chestnut-brown, round, about 1mm. in diameter, pulverulent; teleutospores oblong, deep brown, smooth, strongly constricted at the septum, the two cells readily separating, apex with a long (up to 8μ) acute, hyaline papilla, wall quite uniformly 3½μ thick, cells nearly equal in size and shape, both slightly narrowed from the septum, 40—50×18—20μ; pedicel hyaline, variable in length, up to 80μ long, fragile.

On Saxifraga nudicaulis Don, St. Lawrence Island, Alaska, Macoun. No. 60.

Photo: No. 70a. From the type specimen.
70b. x500. From the same.

The type specimen consists of a few fragments of leaves, so that very little could be examined. The cell wall shows sharply defined through the apical hyaline papilla. The sori contain numerous hyaline, immature teleutospores, as shown in the photographs.

71. Puccinia aspera Diet. & Holw.

Bull. Torr. Bot. Cl. **29**:230. 1902.

III. Teleutosori chestnut-brown, amphigenous, round, early naked and pulverulent, often covering the petioles for many mm.; teleutospores yellowish-brown, elliptical to oblong, mostly with both cells rounded, sometimes narrowed or angular, a small papilla over the germ-pore, verrucose, the tubercles low, flat, very irregular in shape and size but rather closely covering the spore, 30—40×16—22μ; pedicel hyaline, fragile, about the length of the spore.

On Saxifraga Mertensiana Bong. Mt. Paddo, (Mt. Adams) Wash.

Photo: No. 71a. Type specimen.
71b. Type specimen x500.

72. Puccinia turrita Arth.

Bull. Torr. Bot. Cl. **29**:230. 1902.

III. Teleutosori amphigenous, chestnut-brown, soon naked and pulverulent, ½–1mm. in diameter; teleutospores elliptical to oblong, constricted at the septum, both cells rounded, apex mostly rounded, rarely obtusely pointed, with a large light colored papilla, coarsely and irregularly tuberculate, especially at the apex, 36—44×20—24μ; pedicel slender, hyaline, very fragile.

On Saxifraga bronchialis L. Manitou, Col.

Photo: No. 72a. Type specimen.
72b. Same x500.

73. Puccinia pallido-maculata E. & E.

Ellis & Everh. N. A. F. *2234*. 1889.
(without description.)

III. Spots pale yellow; teleutosori amphigenous, small, at first covered by the epidermis, often circinnate in clusters 2–5mm. in diameter, early naked and confluent, pulverulent, chestnut-brown in some specimens, cinnamon-brown in others; teleutospores cinnamon-brown, rarely elliptical or oblong, mostly fusiform, smooth, wall uniformly 1½-2μ thick, germ-pore of the lower cell next the septum, that of the upper cell at the apex, both with a

prominent hyaline papilla, not constricted at the septum, 28—36×14—16μ; pedicel hyaline, fragile, short.

On Saxifraga Lyallii Engler, Canada, S. punctata L. Mont., Utah., Col., Wash.

Exsic: Ellis & Everh. N. A. F. *2234.* Sydow Ured. *1933.*
Photo: No. 73a. Type specimen.
73b. Same x500.

Dr. Dietel has referred this to Puccinia Adoxae, from which it seems distinct. It is a common species in Canada and Colorado.

74. Puccinia Heucherae (Schw.) Diet.

Ber. Deutsch. Bot. Ges. **9**:42. 1891.

Syn: Uredo Heucherae Schw. Schrift Nat. Ges. Leipzig :71. 1822.
Puccinia Saxifragae Schlecht. Fl. Berol. **2**:134. 1824.
Caeoma Saxifragarum Schlecht. l. c. **121.**
Caeoma Heucherae Link. Linne. Sp. Pl. **6**²:28. 1825.
Puccinia inquinans Saxifragae Wallr. Fl. Crypt. Germ. **2**:219. 1833.
Puccinia papillata Bon. Abhl. Nat. Ges. Halle. **5**:219. 1860. p. p.
Puccinia Saxifragae Fckl. Jahrb. Nass. Ver. Naturk. **23**:53. 1869.
Puccinia Tiarellae B. & C. Grev. **3**:53. 1874.
Puccinia spreta Peck. Rep. N. Y. Mus. **29**:67. 1878.
Puccinia congregata Hark. Bull. Cal. Acad. Sc. **1**:26. 1884.

III. Spots round, brown, or reddish-brown, or none, often deeply depressed opposite the sori; teleutosori reddish-brown, either amphigenous, hypophyllous or epiphyllous, small, round, either firm or pulverulent, often circinate around a central sorus which has germinated, often thickly covering the leaf and confluent, sometimes minute, scattered, and covered by the epidermis, soon becoming pulverulent; teleutospores broadly elliptical, ovate-oblong, or oblong, smooth to strongly striate, slightly constricted at the septum, apex rounded or obtusely pointed, with a broad thickening up to 8μ, or with light colored papilla-like thickening, lower cell mostly rounded, 28—48×12—20μ; pedicel hyaline, twice the length of the spore and shorter, subpersistent or fragile.

On Mitella nuda L., M. diphylla L., M. pentandra Hook., M. ovalis Greene, M. Breweri Gray, M. trifida Graham, Heuchera cylindrica Dougl., H. micrantha Dougl., H. glabra Willd., Elmera racemosa (Wats.) Ryd. Saxifraga punctata L., S. Mertensiana Bong., Tiarella cordifolia L., T. trifoliata L., T. unifoliata Hook., T. laciniata Hook., Tellima grandiflora R. Brown, Tolmiea Menzesii T. and G. Canada, Mich., Iowa, Penn., Wash., Utah, N. Y., Wisc., Col., Maine, Calif., Alaska.

Exsic: Ellis, N. A. F. *1049. 1463. 1464. 3571.* Ellis & E. Fg. Columb. *1763. 2059.* Sydow Ured. *338. 857. 1925.* Rabh.-Wint. Fg. eur. *4020.*

Photo: 74a. On Saxifraga rotundifolia, Germany, x500.
74. On Saxifraga punctata, Utah, x500.
74c. On Saxifraga rotundifolia, Germany, x500.
74d. On Saxifraga punctata, Utah, x500.
74e. On Saxifraga granulata, Germany, x500.
74f. On Saxifraga punctata, Wash., x500.
74g. On Saxifraga punctata, Wash.
74h. On Heuchera micrantha, Calif. (Puc. congregata E. & H.).
74i. On Mitella nuda, Mich.
74j. On Tiarella cordifolia, Ellis, N. A. F. *1049*, x500.

Sydow, in his Monograph, considers the European Puccinia Saxifragae distinct from the American forms, which he places under Puccinia Heucherae. He says: "Die Art gleicht im Bau der Sporen am meisten der Pucc. Saxifragae Schlect, unterscheidet jedoch sofort durch die Beschaffenheit der Lager. Diese sind fest, nur selten findet man ältere Lager, welche verstäuben."

This distinction fails entirely in a large collection, as many specimens have all the sori pulverulent, including those with perfectly smooth spores. While the extreme forms can be separated into two groups, one with smooth spores the other with striate ones, there are numerous intermediate forms, some showing only the faintest possible striations with the best apochromatic objective, others faintly but distinctly striate, and so on in all grades up to strongly striate. Many of the Western U. S. forms agree in every particular with the European Puccinia Saxifragae, which is also a variable species, although I have seen none with smooth spores. Figures 74a, 74c and 74e show the European specimens, and 74b, 74d and 74f the corresponding American ones; 74j differs in no way except that the spores are smooth.

Further study may show some way of limiting these forms so as to separate them into two species, in which case the striate-spored ones would be Puccinia Saxifragae Schlecht, and the smooth-spored ones would be Puccinia Heucherae (Schw.) Diet.

75. Puccinia Lithophragmae Holway n. sp.

III.—Spots none or pale green; sori chestnut-brown, mostly hypophyllous, small, round, pulverulent, soon confluent in groups 1–3mm. in diameter, or covering the petioles for many mm., with the ruptured epidermis prominent; teleutospores light brown, elliptical to oblong, often constricted at the septum, rounded at both ends or rarely narrowed from the septum, wall of uniform thickness, 1½–2μ, apex with a conical hyaline papilla, epispore prominently reticulated, 32—44×16—20μ; pedicel hyaline, short, fragile.

On Lithophragma parviflora (Hook.) Nutt., Utah, A. O. Garrett.

Photo: No. 75a. Type specimen.
No. 75b. Same x500.

TIARELLA.

76. Puccinia trifoliata E. & E.

Bull. Torr. Bot. Cl. **22**:58. ,1895.

I. Aecidia on the slightly swollen stems and petioles, erumpent, closed at first, soon open and cup-shaped, about ½mm. in diameter, margin toothed, aecidiospores ovate or subglobose, 15—20μ in diameter, yellowish, epispore slightly echinulate.

Saxifragaceae.

II. Uredosori amphigenous, light brown, ⅓–½mm. in diameter, scattered, pulverulent; uredospores pale brown, globose or obovate, echinulate, wall 4μ thick, 20—26μ in diameter, germ-pores equatorial, 4?.

III. Teleutosori amphigenous, dark brown, ½–1mm. in diameter, scattered, pulverulent; teleutospores chestnut-brown, elliptical, rounded at each end, slightly or not at all constricted, closely covered with a net-work of lines, apex not thickened, wall uniformly 2μ thick, 30—40×20—24μ; pedicel hyaline, short fragile.

On Tiarella trifoliata L. Seattle, Wash. (Piper).

Photo: 76a. From the type specimen.
76b. Same x500.
The part of type examined was without aecidia and Ellis' description is used.

77. Puccinia Parnassiae Arthur.

Bull. Torr. Bot. Cl. **31**:3. 1904.

III. Teleutosori amphigenous, dark brown, scattered or clustered, soon confluent, pulverulent, ruptured epidermis prominent; teleutospores elliptical to oblong, mostly rounded at both ends, occasionally a little angular, wall uniformly 1½–2μ thick, minutely verrucose, especially on the upper cell, germ-pore of the lower cell at the septum or a little below it, that of the upper cell at the apex, each with a small hyaline papilla, 28—36×16—20μ; pedicel hyaline, subpersistent, up to 50μ long.

On Parnassia fimbriata Banks, Utah, Canada.

Exsic: Sydow Ured. *1934*. Garrett. Fg. Utah, *24*.
Photo: No. 77a. Type specimen.
77b. Same x500.
Not uncommon in mountain meadows of Alberta and British Columbia.

RIBES.

78. Puccinia Parkerae Diet. & Holw.

Erythea **3**:78. 1895.

III. Teleutosori hypophyllous, opposite brown or reddish depressed spots, round, firm, pulvinate, rarely solitary, mostly in groups 2–5 mm. in diameter, often confluent, especially on the pedicels, which are sometimes distorted by the long sori, long covered by the epidermis, which finally ruptures and remains prominent until the sori are old; teleutospores yellowish-brown, the apex dark brown, oblong to clavate, constricted at the septum, apex rounded and strongly thickened, up to 10μ, lower cell rounded, or longer and narrowed to the base, 36—48×14—20μ; pedicel hyaline, persistent, up to 60μ long.

On Ribes lacustre (Pers.) Poir., Wash., British Columbia.

Exsic: Ellis N. A. F. *3242.*
Photo: No. 78. From the type.

This species very closely resembles some of the Carex Puccinias which have their aecidial stages on Ribes. Fisher, Beitr. z Kryptfl. der Schweiz **1**:109, 1898, has called attention to such resemblances in several cases. He says: "In seiner Bearbeitung der Uredineen für die natürlichen Pflanzenfamilien von Engler und Prantl. weist Dietel darauf hin, das eine auffallende übereinstimmung bestehe zwischen den Teleutosporen der aut Rhamnus-Arten lebenden Puccinia Mesneriana Thüm. und diejenigen der Gruppe von Puccinia coronata, welche bekanntlich auf Rhamnus-Arten ihre Aecidien bilden; das gleiche hebt er auch hervor für diejenigen von Puccinia ornata Arth. & Holw. auf Rumex brittanica und diejenigen von Puccinia Phragmitis.

"Ganz unabhängig von Dietel waren mir bei meiner Beschäftigung mit Uredineen eine Reihe von derartigen Beziehung ebenfalls aufgefallen; man kann dieselben in folgende Satze zusammenfassen:: Auf den Nährpflanzen der Aecidiengeneration bestimmter heteroecischer Arten kommen auch Lepto-formen vor, deren Teleutosporen mit denen der betreffenden heteroecischen Art annährend oder völlig übereinstimmen. * * * Es bleibt hier kaum eine andere Vorstellung übrig als die, dass die betreffenden Uredineen ursprünglich omni-oder doch plurivor gewesen seien, dass also z. B. Puccinia coronata sowohl auf Gramineen als auf Rhamnus-Arten ihre ganze Entwicklung durchzumachen befähigt war: bei den Descendenten wäre dann eine Specialisation eingetreten in der Weise, dass einen Abkömmlinge eine schärfere Anpassung des einen Entwicklungsgliedes (Aecidiengeneration) an Rhamnus, des andern (Uredo-Teleutosporengeneration) an Gramineen erfahren hätten, während andere Abkömmlinge einen Theil ihrer Sporenformen (Aecidien und Uredo) eingebüsst und sich zugleich auf eine der verschiedenen Nährpflanzen (Rhamnus) specialisiert hätten."

79. Puccinia Ribis DC.

Flora fr. **2**:221. 1805.

Syn: Puccinia bullata Lk. *Mag. Gesells. Naturf. Freunde Berlin. **8**:29. 1816.
Puccinia Acerum Lk. Linne Sp. Pl. **6**²:80. 1825.
Puccinia pulchella Pk. Rep. N. Y. State Mus. **25**:111. 1873.
Puccinia Grossulariae (Gmel.) Wint. p. p. Rabh. Krypt. Fl. **1**:198 1884.
Puccinia granulata De By. *Rabh. Herb. Mycol. **2**:499.
Puccinia Ribis papillifera Lagerh. Hedw. **28**:107. 1889.

III. Teleutosori epiphyllous, small, soon naked and pulverulent, mostly circinnate around 1–4 central sori, the groups 2–3mm. in diameter, usually surrounded by a yellow zone, reddish in one collection; teleutospores brown, elliptical to oblong, rounded at both ends or both cells somewhat narrowed from the septum, not constricted, wall quite uniformly 2—3μ thick, verrucose, the tubercles short and rather distant, germ-pore of the upper cell at the apex, that of the lower cell near the pedicel, each covered by a hyaline papilla, 26—36×16—20μ, in the Michigan specimen, 28—40×14—16μ; pedicel slender, hyaline, fragile, about the length of the spore.

On Ribes rubrum L. N. Y., Mich., Minn., Canada.

Exsic: Thuem. Mycoth, univ. *544.*
Photo: No.79a. From Minn.
No. 79b. From Mich. x500.
No. 79c. From Vesterg. Micr. rar. sel. 564, on Ribes petraeum, Switzerland. x500.

Lagerheim made his variety papillifera from specimens collected in Canada, but an examination of a large number of collections shows that the papilla is as large in some European specimens. In general the European form has darker spores with rather thicker walls and the spores are more rounded at the ends. A specimen from Sweden agrees in every particular, however, with the Michigan specimen, except a slight difference in color.

Erikson has made some cultures from which he infers that the form on Ribes rubrum is specialized and that it will not grow on other species of Ribes.

CRASSULACEAE.

SEDUM.

80. Puccinia Rhodiolae B. & Br.

*Ann. & Mag. Nat. Hist. :462. 1850.

Syn: Puccinia Rhodiolae Blytt. Vid.-Selsk. Forh. :— (10). 1882.
Puccinia Blyttii De Toni. Sacc. Syll. 7:700. 1887.

III. Teleutosori pulverulent, chestnut-brown, amphigenous, small, round surrounded by the ruptured epidermis, finally confluent, often covering the entire leaf; teleutospores cinnamon-brown, globose to broadly elliptical, smooth, rounded at both ends, cells nearly equal, wall of uniform thickness, germ-pore of the upper cell at the apex, that of the lower cell near the pedicel, both covered with a light colored papilla, 28—36×22—26μ; pedicel the length of the spore and shorter, hyaline, fragile.

On Sedum roseum (L.) Scop. Argentine Pass, Georgetown, Col. (Holway.)

Photo: No. 80.
A rare species, known only from England and Norway.

ROSACEAE.

SIEVERSIA.

81. Puccinia Sieversiae Arth.

Bull. Torr. Bot. Cl. 31:3. 1904.

III. Teleutosori amphigenous, mostly hypophyllous, scattered, round or oval, at first covered by the thin epidermis, soon naked, pulverulent, brown; teleutospores cinnamon-brown, elliptical or obovate-oblong, rounded at both ends, or somewhat narrowed below, rarely slightly constricted, very minutely and evenly verrucose, wall uniformly 2–2½μ thick, apex with a

broad light colored papilla, 32—40×20—26μ; pedicel fragile, half the length of the spore and shorter, hyaline.

On Sieversia turbinata (Rydb.) Greene, Utah.

Photo: No. 81a. From the type.
No. 81b. x500.

WALDSTEINIA.

82. Puccinia Waldsteinae Curt.

Grev. **3**:54. 1874.

III. Spots pale green to brown, or none, often deeply depressed opposite the sori; teleutosori hypophyllous, scattered, black, firm, pulvinate round, 1–2mm. in diameter, surrounded by the ruptured epidermis; teleutospores pale brown, smooth, oblong-clavate to clavate, strongly constricted at the septum, lower cell narrowed to the pedicel, apex much darker, rounded or obtusely pointed, mostly 8–12μ thick, 40—56×12—18μ; pedicel tinted, persistent, up to 90μ long.

On Waldsteinia fragarioides (Michx.) Tratt.

Exsic: Ellis N. A. F. *1050*. Fungi Columb. *1775*. New York., Wisc.
Photo: No. 82. From Fungi Columb. *1775*.

83. Puccinia Pruni-spinosae Pers.

Syn. Meth. :226. 1801.

Syn: Puccinia Pruni A. & S. Consp. :131. 1805.
Puccinia Pruni DC. Flora fr. **2**:222. 1805.
Puccinia gemella Hedw. Lamarck, Encyc. Method. **8**:249. 1808.
Uredo prunastri DC. Fl. fr. **6**:85. 1815.
Puccinia prunorum Lk. Linne, Sp Pl. **6**²:82. 1825.
Puccinia Salicum Lk. l. c. :83.
Puccinia fusca prunastri Wall. Fl. Crypt. **2**:220. 1833.
Puccinia fusca pruni Wallr. l. c.
Uredo Pruni Mont. Hist. Nat. Canar. **3**:(90). 1840.
Uredo Pruni Cast. *Obs. **1**:27. 1842.
Caeoma porphrogeneta. *Tijds. Nat. Gesch. **11**:409. 1844.
Lecythea Pruni-spinosae (DC.) Lev. Ann. Sc. Nat. **8**:374. 1847.
Uredo Castagnei Mont. Castagne, Cat. Pl. Mars. Supp. :88. 1851.
Uromyces placentula Mont. Gay, Hist. Chile. **8**:49. 1852.
Puccinia verrucosa Bon. Abhl. Nat. Ges. Halle. **5**:219. 1860.
Uromyces prunorum Fckl. Ann. Soc. Nass. **15**:20. 1861.
Puccinia prunorum Fckl. Jahrb. Ver. Naturk. **23**:49. 1869.
Puccinia discolor Fckl. l. c. :50.

II. Spots yellowish or purple, angular and irregular; uredosori hypophyllous, minute, scattered or thickly covering the leaf, cinnamon-brown; uredospores light yellow or brownish, rarely globose, mostly ovate,

elliptical or pyriform, apex brown, rounded, up to 8μ thick, closely verrucose, the thickened apex usually smooth, tubercles larger towards the base, 20—36×14—20μ; germ-pores 2–3, equatorial; paraphyses very numerous, capitate, thick-walled, brownish, mature heads about 20×14—16μ; teleutosori following in the uredosori from cinnamon-brown to chestnut-brown, pulverulent; teleutospores varying in different specimens from yellowish-brown to dark brown, mostly with both ends rounded and the two cells of the same shape and size, very strongly constricted at the septum and easily separating, rarely with the lower cell smaller and narrowed to the base, thickly covered with large, pointed tubercles, 32—44×20—26μ; pedicel slender, hyaline, fragile, the lower part of several pedicels frequently agglutinated, the free portions about 40μ long.

On the various species of wild and cultivated Prunus throughout the U. S. and also in Mexico, on Prunus sp.

Exsic: Ellis, N. A. F. *262. 1047. 1869. 1048.* Fungi Columb. *1580. 1655. 1864.* Carleton, Ured. Am. *30.* Sydow, U

Photo: No. 83a. On Prunus Persica, Miss.
83b. On Prunus Besseyi, Kansas.

Sydow, in his Monograph, describes two kinds of Uredospores, one kind thickened at the apex and the other unthickened, but only one kind exists, as has already been shown by McAlpine, who also describes the teleutospores as follows: "If the teleutosori are examined with a magnifying glass before they are too far advanced, the teleutospores are seen to be arranged in little clusters or balls which stand out distinctly, especially at the margin. Sometimes a solitary ball can be seen on the top of a uredosorus, and then gradually they spread and stud it all over until the uredospores are entirely replaced. If a leaf is shaken over a slide, myriads of these little balls are detached and the clusters are seen to consist of a number of spores, even reaching to 20 or more.

When a longitudinal section is obtained of a cluster, the mode of arrangement is evident. A number of elongated stalks have become agglutinated together, and the free end of each bending over bears a spore. The pedicel of the teleutospore is described as short, hyaline and deciduous, but this merely refers to the free portion of the apex. The whole somewhat resembles a minute Stilbum with its head of spores."

These compound pedicels can be shown in dried material by soaking the leaf for sometime and carefully crushing a piece of the leaf with a sorus. Sections show that this arrangement of pedicels exists more or less in a number of species.

Uromyces Amygdali Pass. and Uromyces Amygdali Cooke have also been used for this species, but I have been unable to find where they were first published.

In 1904 Tranzschel of St. Petersburg showed by cultures that this Puccinia has its aecidial stage on Anemone, the common Aecidium punctatum Pers. Arthur has since repeated the experiment, using the aecidiospores from Hepatica acutiloba, and concludes that "From these results there can be no further question of the general identity of the American and European plum and cherry rusts, and their connection with Aecidium punctatum."

Dr. Tranzschell says: Es sei noch erwähnt, dass die Uredosporen von Puccinia Pruni spinosae, welche ich im Herbst 1902 aus Montpellier erhalten und in St. Petersburg in Leinwandsäcken im Freien überwintert hatte, gegen Ende des Winters keimfähig waren. Deshalb scheint die Puccinia sich auch mittels der Uredosporen erhalten zu können, und da das Myceliums des Aecidiums perennirt, so können die Generationen auf beiden Nährpflanzen selbständig, räumlich von einander entfernt, angetroffen werden."

PLATE II

MORACEAE.

Ficus. (?)

46. Puccinia sepulta B. & C. From the type collection, Nicaragua. ×250.

SANTALACEAE.

Comandra.

[illegible] On Comandra pallida, Utah. ×50.

ARISTOLOCHIACEAE.

Asarum.

[illegible] ×50.

POLYGONACEAE.

Rumex.

40. Puccinia ornata Arth. & Holw. From the type specimen, Minn. ×250.
50a. Puccinia punctiformis D. & H. From the type specimen, Calif. ×250.
50b. Puccinia punctiformis D. & H. From the type specimen, Cali[illegible] ×

PLATE 11

MORACEAE.

Ficus. (?)

No.
46. Puccinia sepulta B. & C. From the type collection, Nicaragua. ×250.

SANTALACEAE.

Comandra.

47. Puccinia Comandrae Peck. On Comandra pallida, Utah. ×250.

ARISTOLOCHIACEAE.

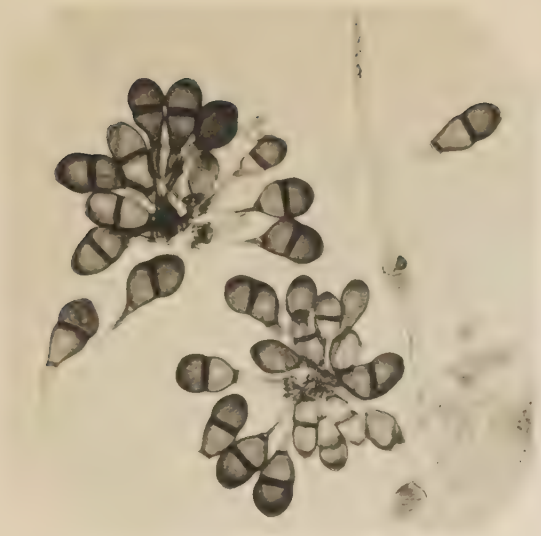
Asarum.

48. Puccinia asarina Kze. On Asarum caudatum. Wash. ×250.

POLYGONACEAE.

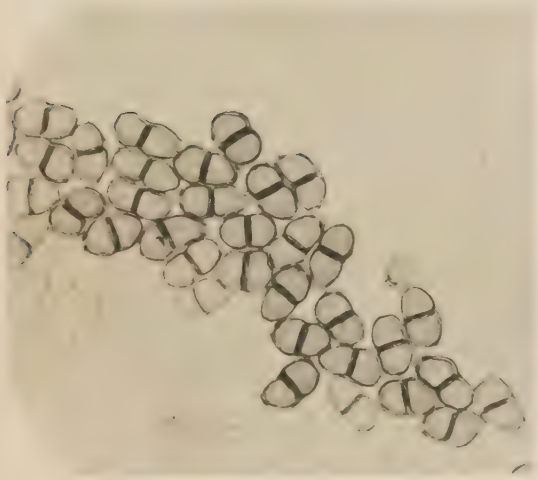
Rumex.

49. Puccinia ornata Arth. & Holw. From the type specimen, Minn. ×250.
50a. Puccinia punctiformis D. & H. From the type specimen, Calif. ×250.
50b. Puccinia punctiformis D. & H. From the type specimen, Calif. ×250.

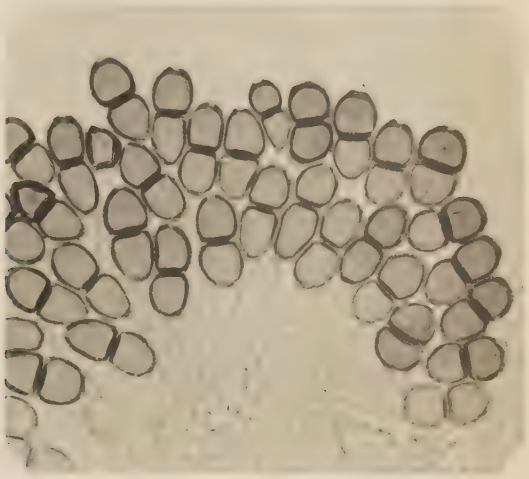


46

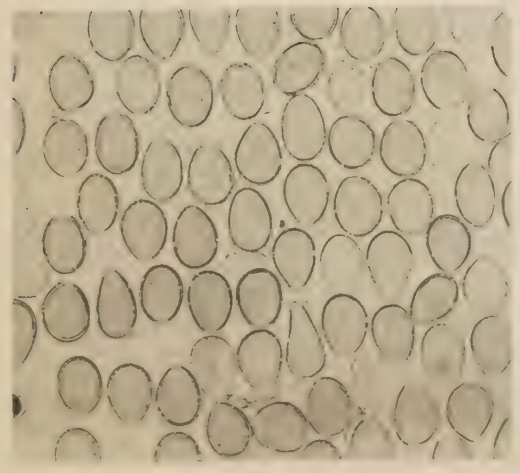
47



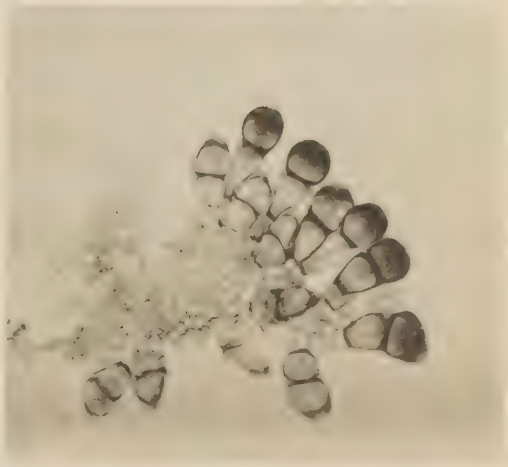
48



49



50a



50b

PLATE 12

Rumex. (Continued.)

No.

51a. Puccinia acetosae (Schum.) Koern. On Rumex hastatulus. Fla. ×250.

51b. Puccinia acetosae (Schum.) Koern. On Rumex arifolius. Germany. ×250.

Oxyriae.

52a. Puccinia Oxyriae Fckl. On Oxyria digyna. Col. ×250.

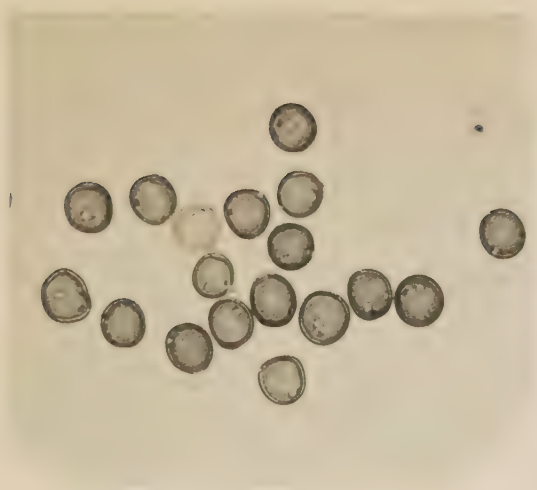
52b. Puccinia Oxyriae Fckl. On Oxyria digyna. Col. ×250.

Polygonum.

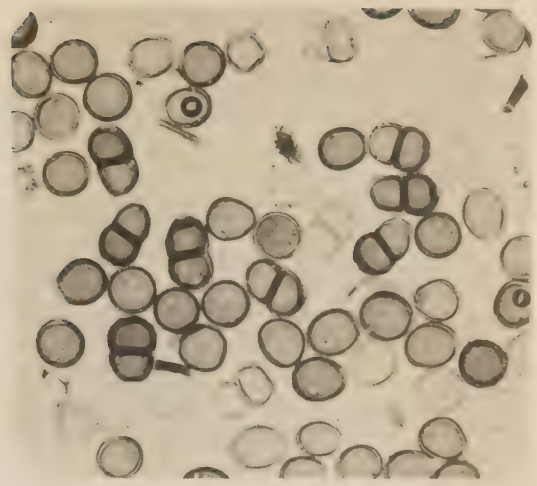
53a. Puccinia Bistortae (Str.) DC. On P. bistortoides. Col. ×250.

53b. Puccinia Bistortae (Str.) DC. On P. bistortoides. Col. ×250.

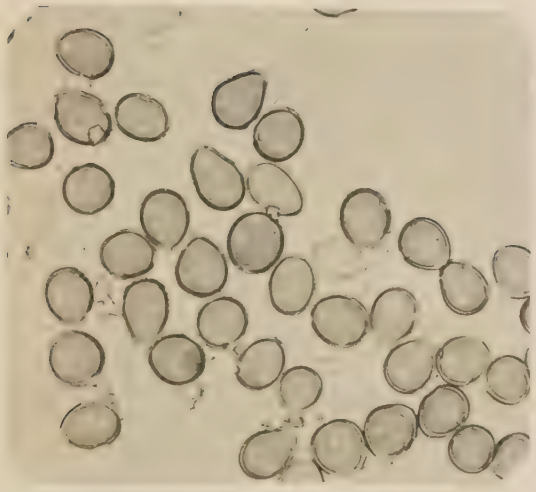
53c. Puccinia Bistortae (Str.) DC. From type of Puccinia uniformis. ×250.



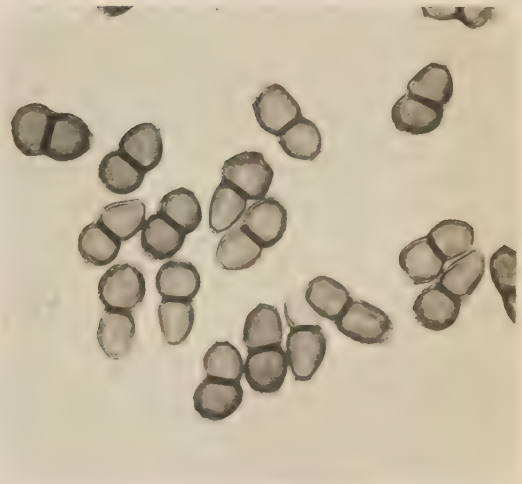
51a



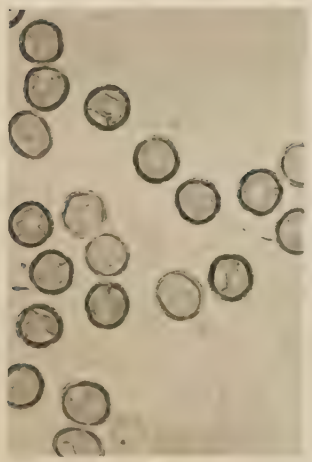
51b



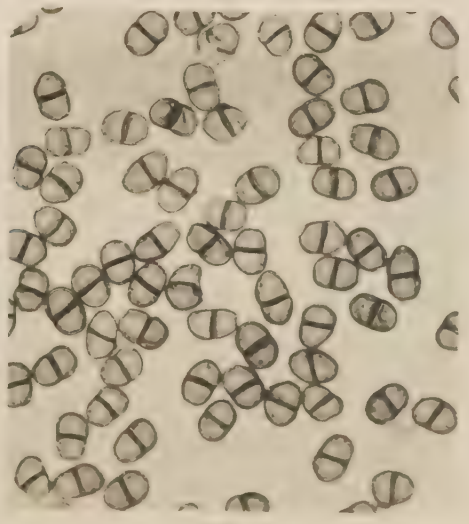
52a



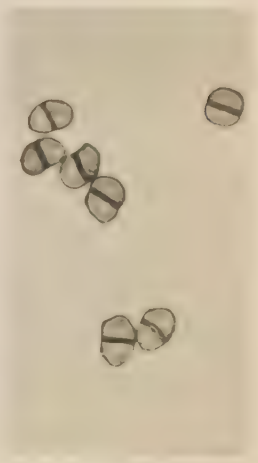
52b



53a



53b



53c

PLATE 13

Polygonum. (Continued.)

No.

54a. Puccinia amphispilusa D. & H. From the type specimen, Calif. ×250.

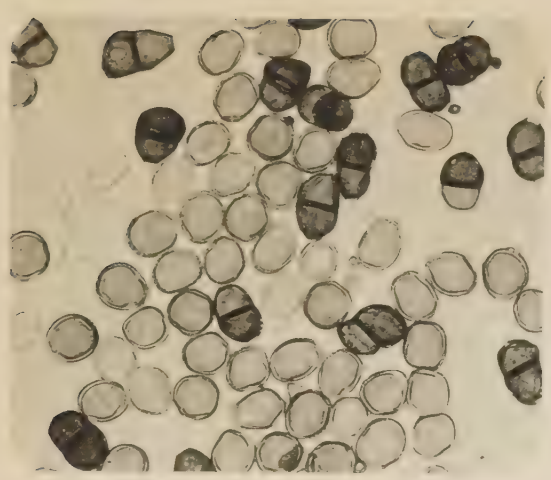
54b. Puccnia amphispilusa D. & H. From the type specimen, Calif. ×250.

55a. Puccinia Polygoni-amphibii Pers. On Polygonum Convolvulus. Ohio. ×250.

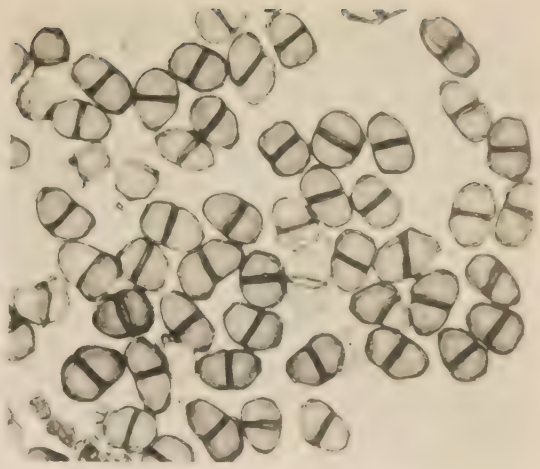
55b. Puccinia Polygoni-amphibii Pers. On Polygonum emersum. Mass. ×250.

56a. Puccinia septentrionolis Juel. ? On Polygonum scandens. New Jersey. ×250.

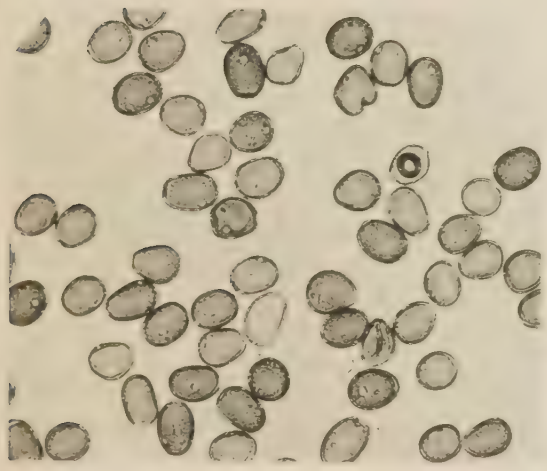
56b. Puccinia septentrionalis Juel. ? On Polygonum scandens. New Jersey. ×500.



54a

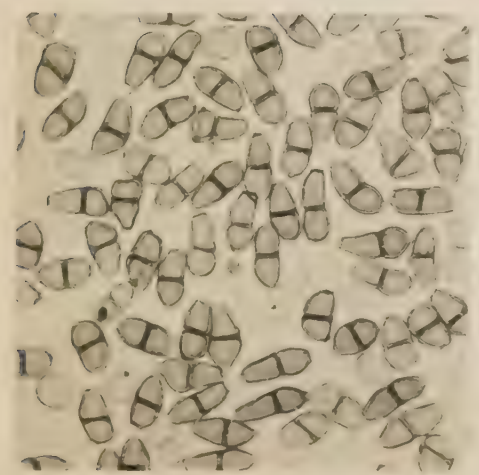


54b

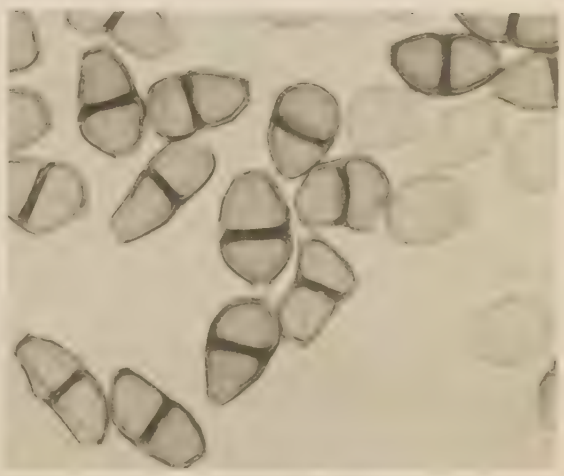


55a

55b



56a



56b

PLATE 14

Polygonum. (Continued).

No.

56c. Puccinia septentrionalis Juel. On Polygonum viviparum. Sweden. ×500.

AMARANTACEAE.

Guillemineae.

57a. Puccinia Guillemineae D. & H. On Guilleminea illecebroides. Guadalajara. ×250.

57b. Puccinia Guillemineae D. & H. On Guilleminea illecebroides. Guadalajara. ×250.

Iresine.

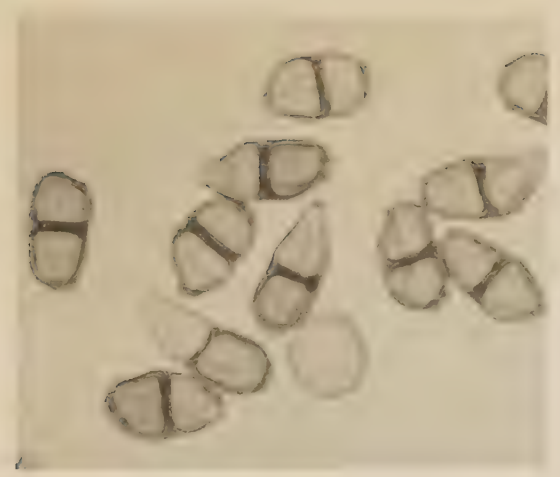
58a. Puccinia macropoda Speg. On Iresine sp. Cuba. ×250.

58b. Puccinia macropoda Speg. On Iresine sp. Cuba. ×500.

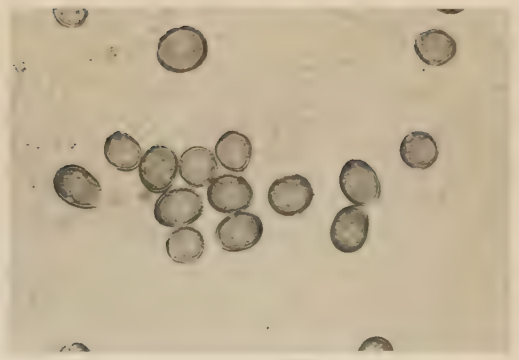
PORTULACEACEAE.

Claytonia. Montia.

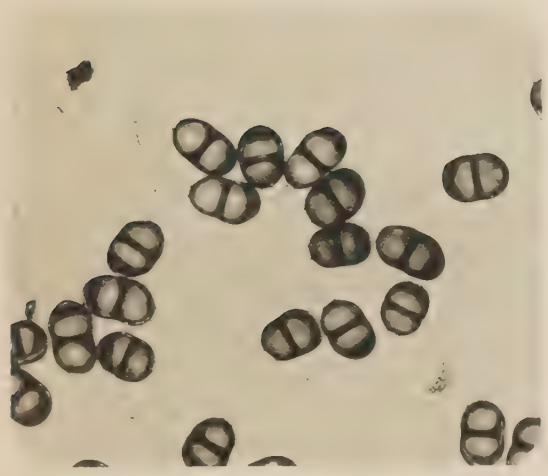
59. Puccinia Claytoniata (Schw.) Syd. On Claytonia Virginica. Ohio. ×250.



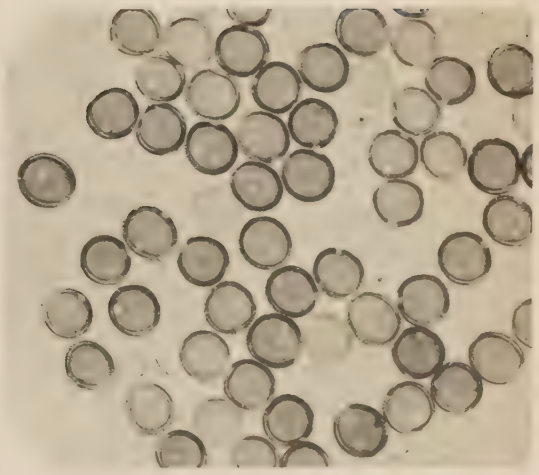
56c



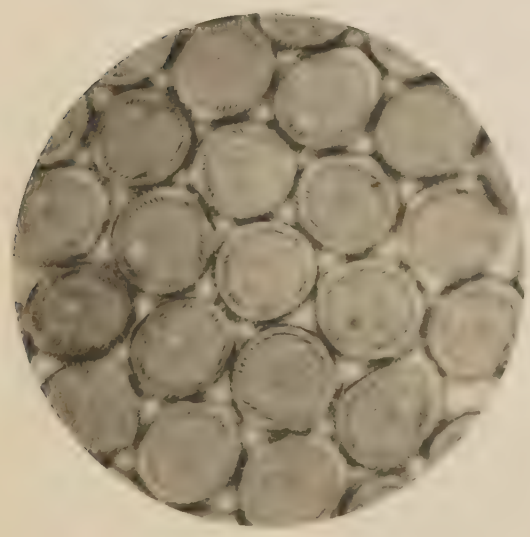
57a



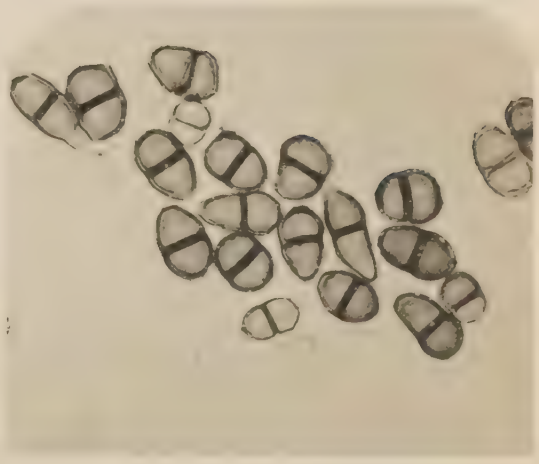
57b



58a



58b



59

PLATE 15

CARYOPHYLLACEAE.

Stellaria. Cerastium. Dianthus. Spergula.

No.

60a. Puccinia Arenariae (Schum.) Wint. On Stellaria longipes. Alaska. ×250.

60b. Puccinia Arenariae (Schum.) Wint. On Spergula arvensis. N. Y. ×250.

60c. Puccinia Arenariae (Schum.) Wint. On Dianthus barbatus. Penna. ×250.

Arenaria.

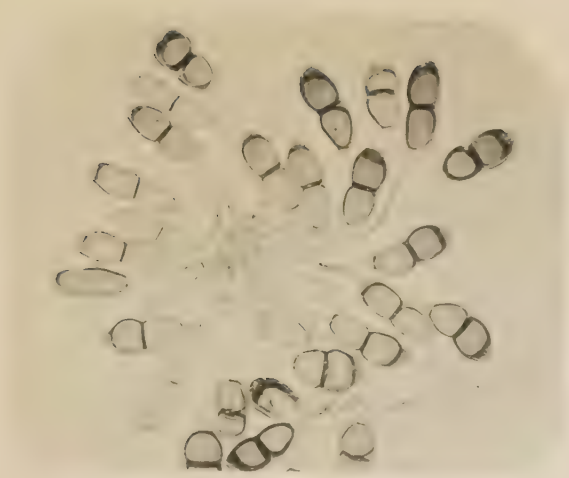
61. Puccinia hysteriformis Peck. On Arenaria Uintahensis. Utah. ×250.

62. Puccinia modica Holw. On Arenaria sp. Etla, Oaxaca, Mex. ×250.

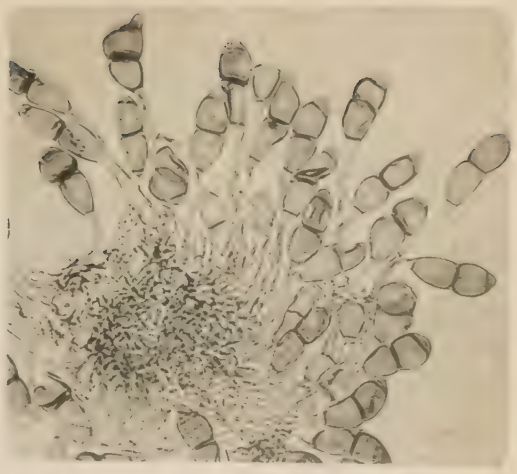
CRUCIFERAE.

Arabis. Erysimum. Cheiranthus. Draba.

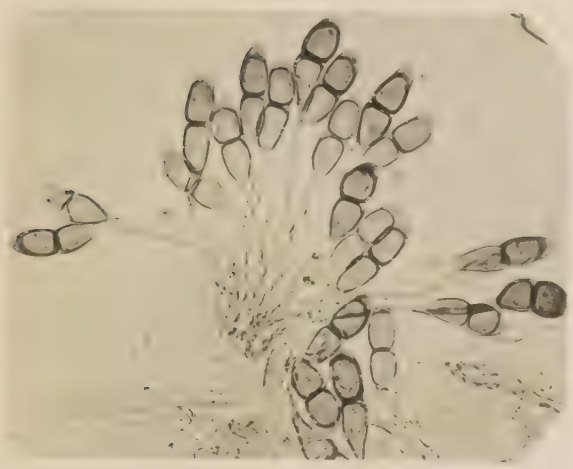
63a. Puccinia Holboellii (Hornem.) Rostr. On Arabis Holboelli. Calif. ×250.



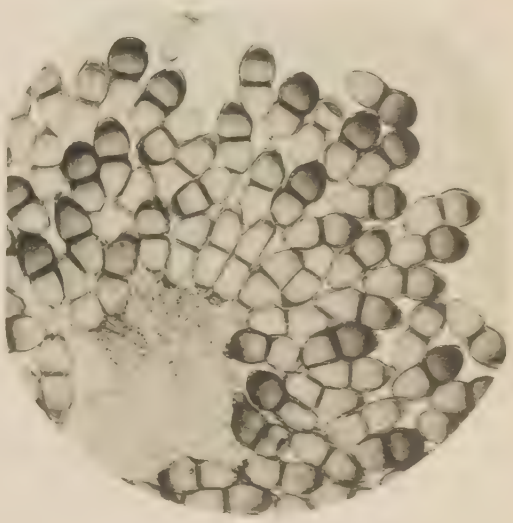
60a



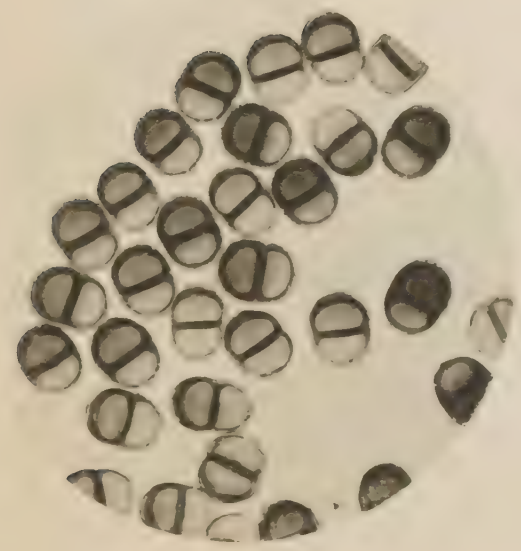
60b



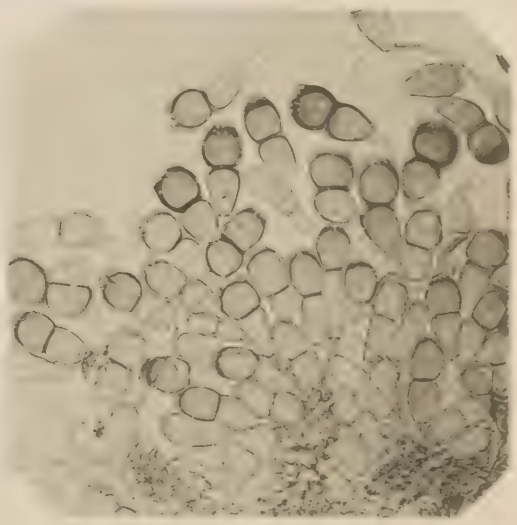
60c



61



62



63a

PLATE 16

Arabis. Erysimum. Cheiranthus. Draba. (Continued.)

No.

63b. Puccinia Holboellii (Hornem.) Rostr. On Arabis Holboelli. Calif. ×250.

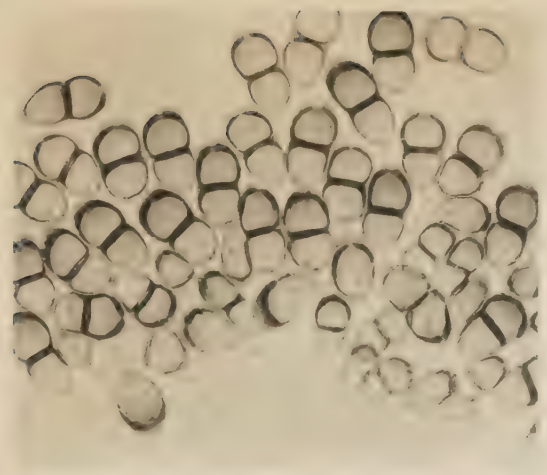
63c. Puccinia Holboellii (Hornem.)Rostr. On Erysimum hieracifolum. Finland. ×250.

63d. Puccinia Holboellii (Hornem.) Rostr. On Cheiranthus pygmaea. Grinnell Land. Type of Puccinia Cheiranthi E. & E. ×250.

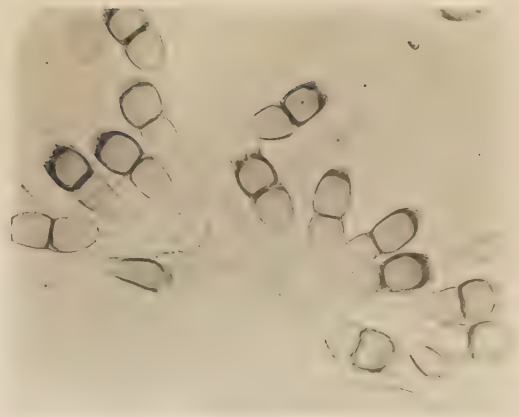
63e. Puccinia Holboellii (Hornem.) Rostr. On Arabis Holboelli. Utah. ×250.

63f. Puccinia Holboellii (Hornem.) Rostr. Type of Puccinia Barbareae Cke. Ore. ×250.

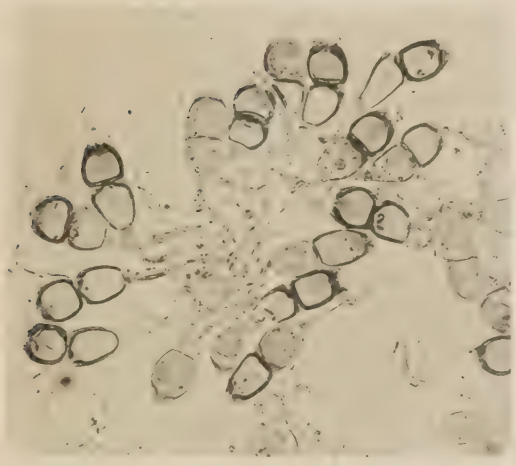
63g. Puccinia Holboellii (Hornem.) Rostr. On Arabis Holboelli. Calif. Type of Puccinia palefaciens D. & H. ×250.



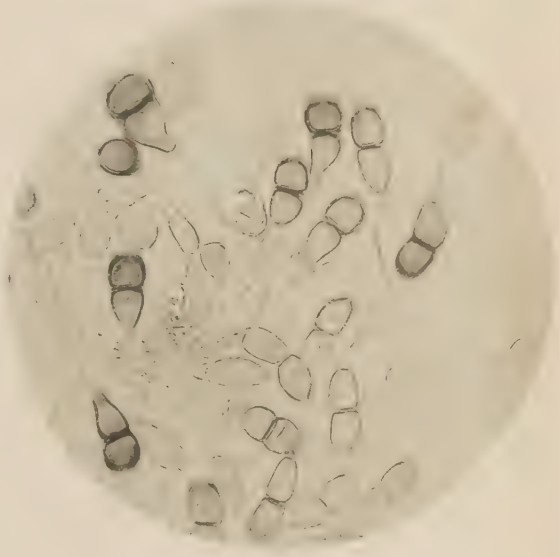
63b



63c



63d



63e

63f

63g

PLATE 17

Arabis. Erysimum. Cheiranthus. Draba. (Continued.)

No.

63h. Puccinia Holboellii (Hornem.) Rostr. On Arabis perannans. Calif. (Puccinia palefaciens D. & H.) ×250.

63i. Puccinia Holboellii (Hornem.) Rostr. On Sisymbrium linifolium. Mont. (Puccinia consimilis E. & E.) ×250.

63j. Puccinia Holboellii (Hornem.) Rostr. On Draba speciosa. Col. ×250.

Draba.

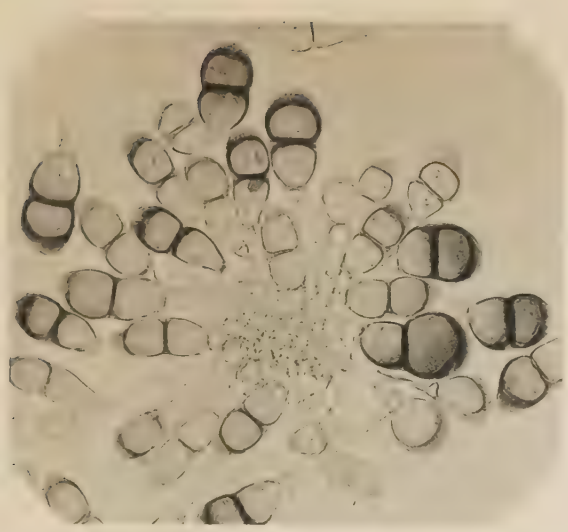
64. Puccinia Drabae Rud. On Draba arabisans. Canada. ×250.

Arabis. Smelowskia.

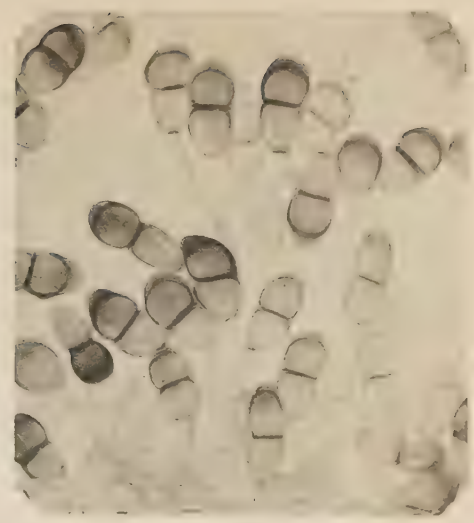
65. Puccinia aberrans Peck. On Smelowskia Americana. Utah. ×250.

Thlaspi.

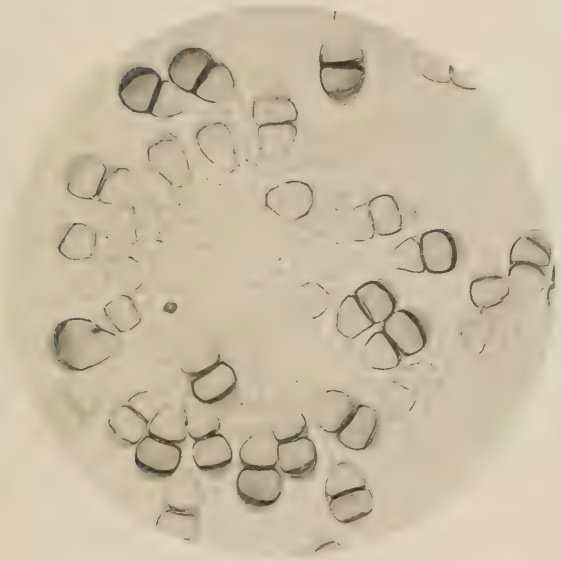
66. Puccinia Thlaspeos Schubert. On Thlaspi glaucum. Utah. ×250.



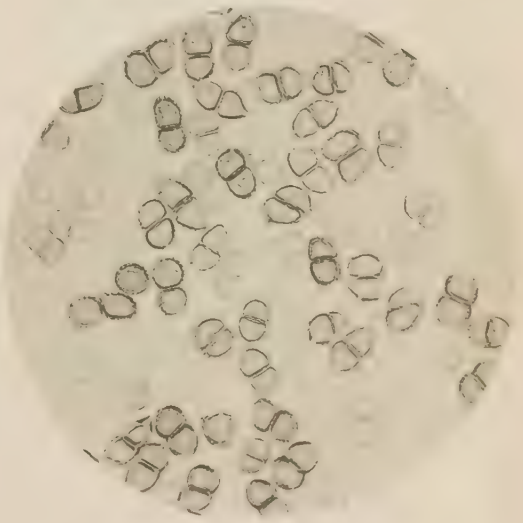
63h



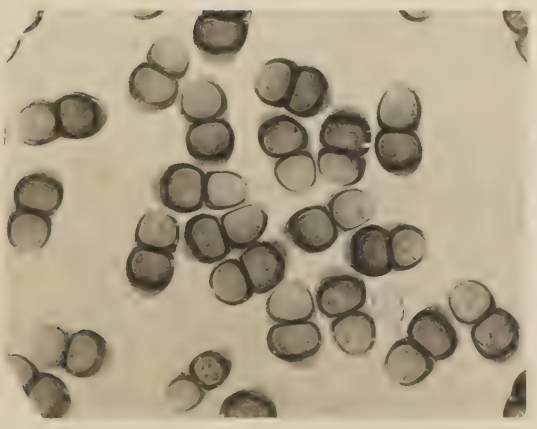
63i



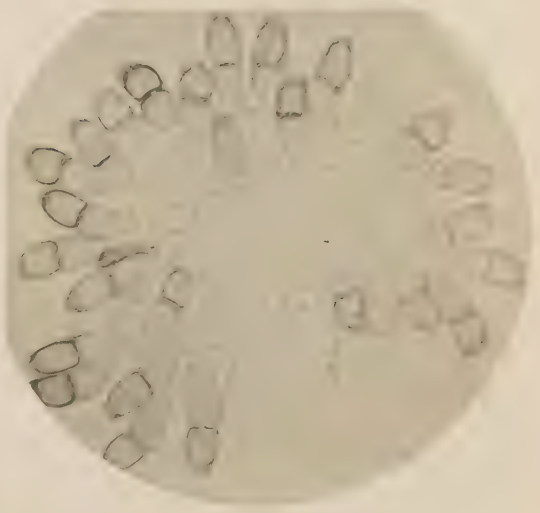
63j



64



65



66

PLATE 18

Thlaspi. (Continued.)

No.
67. Puccinia Utahensis Garrett. On Thlaspi glaucum. Utah. ×250.

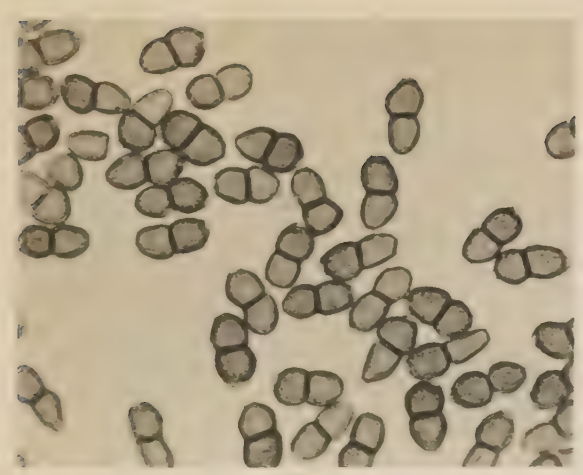
SAXIFRAGACEAE.

Saxifraga. Heuchera. Mitella.

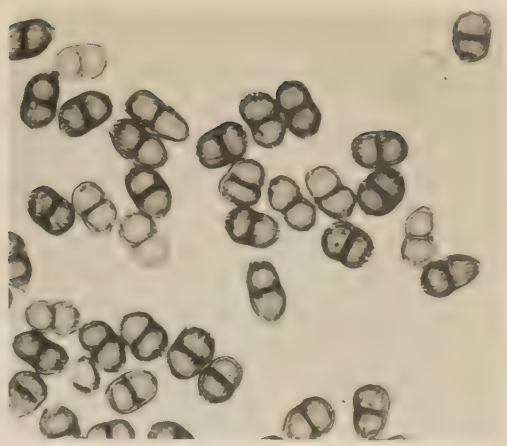
68a. Puccinia curtipes Howe. On Heuchera ovalifolia. Canada. ×250.
68b. Puccinia curtipes Howe. On Saxifraga nivalis. Canada. ×500.

Saxifraga.

69. Puccinia Chrysoplenii Grev. On Saxifraga punctata. Col. ×250.
70a. Puccinia Laurentiana Trel. On Saxifraga nudicaulis Type. ×250.
70b. Puccinia Laurentiana Trel. On Saxifraga nudicaulis Type. ×500.

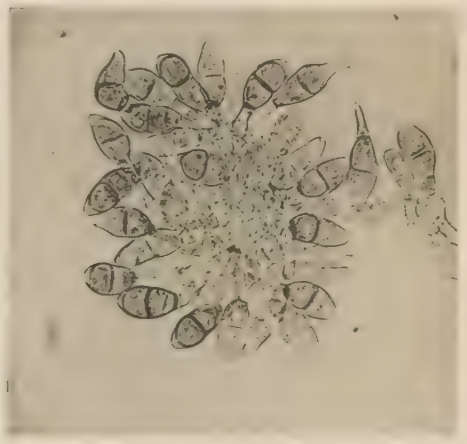


67



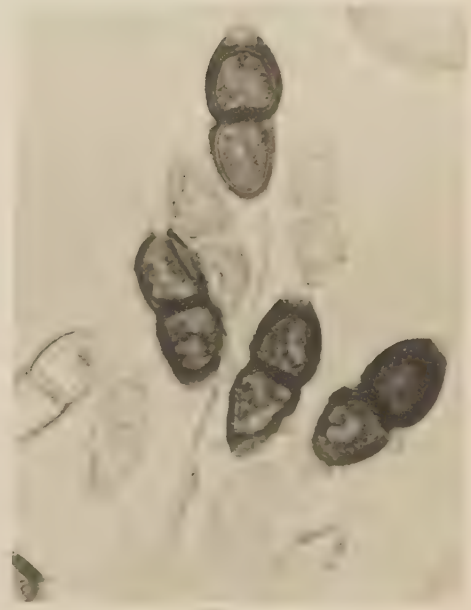
68a

68b



69

70a



70b

PLATE 19

Saxifraga. (Continued.)

No.

71a. Puccinia aspera Diet. & Holw. On Saxifraga Mertensiana. Wash. ×250.

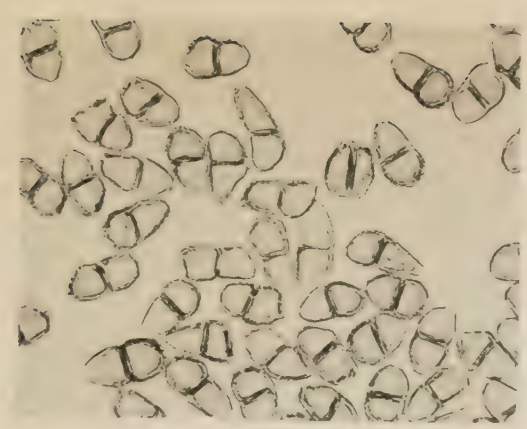
71b. Puccinia aspera Diet. & Holw. On Saxifraga Mertensiana. Wash. ×500.

72a. Puccinia turrita Arth. On Saxifraga bronchialis. Col. ×250. Type.

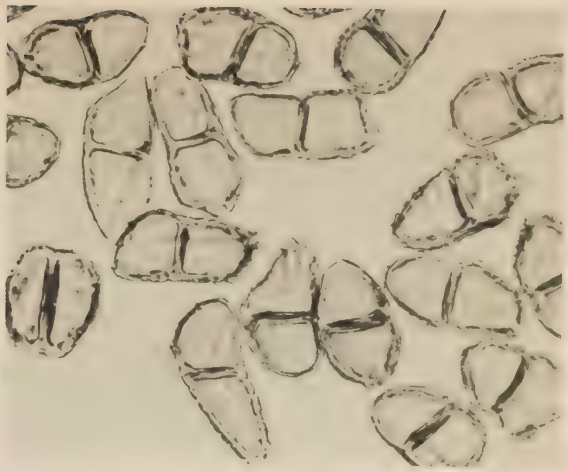
72b. Puccinia turrita Arth. On Saxifraga bronchialis. Col. ×500.

73a. Puccinia pallido-maculata E. & E. On Saxifraga punctata. Col. ×250. Type.

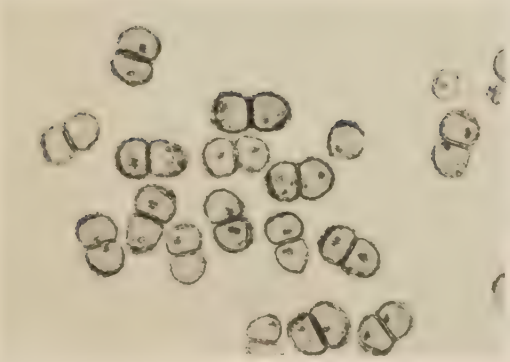
73b. Puccinia pallido-maculata E. & E. On Saxifraga punctata. Col. ×500. Type.



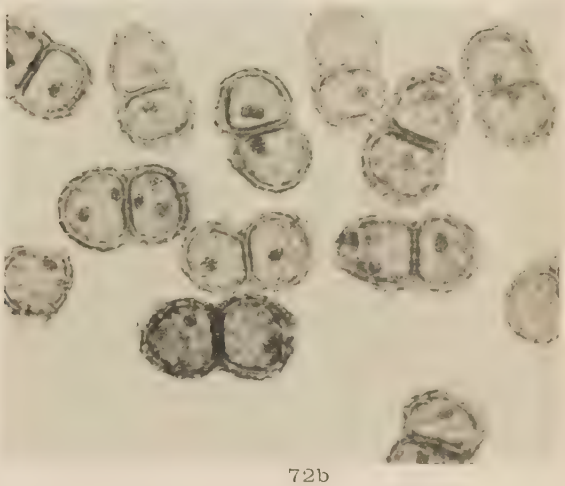
71a



71b

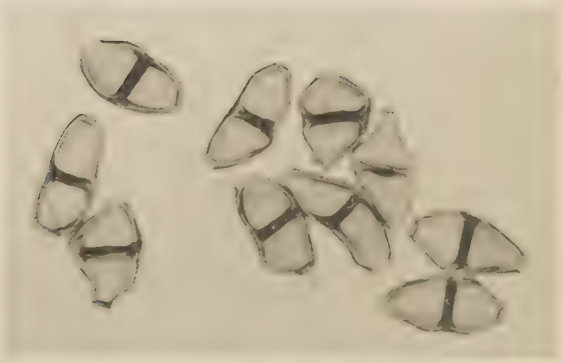


72a

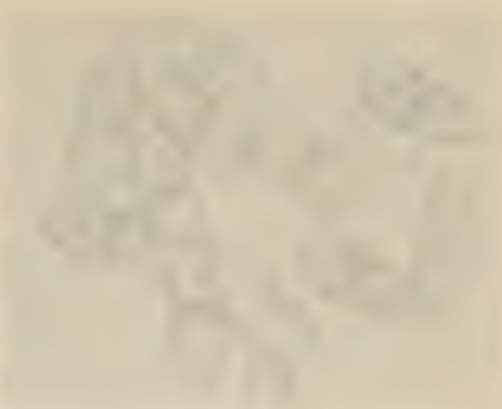


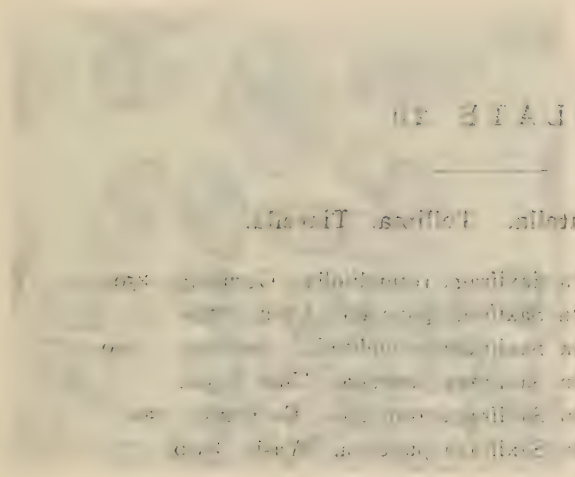
72b

73a



73b





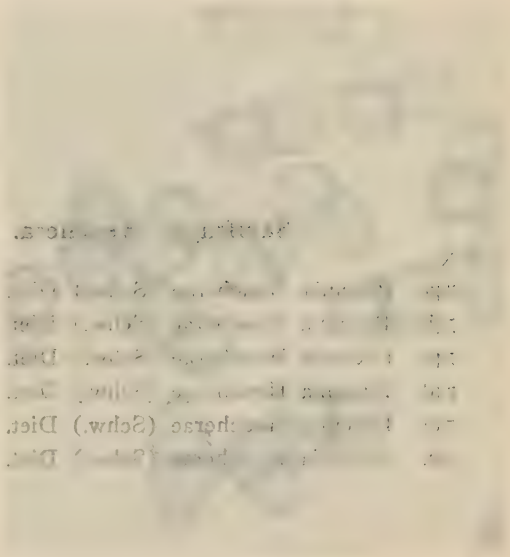


PLATE 20

Saxifraga. Heuchera. Mitella. Tellima. Tiarella.

No.

74a. Puccinia Heucherae (Schw.) Diet. On Saxifraga rotundifolia. Germany. ×500.

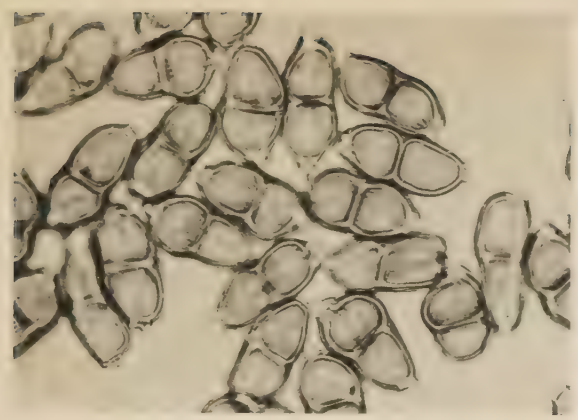
74b. Puccinia Heucherae (Schw.) Diet. On Saxifraga punctata. Utah. ×500.

74c. Puccinia Heucherae (Schw.) Diet. On Saxifraga rotundifolia. Germany. ×500.

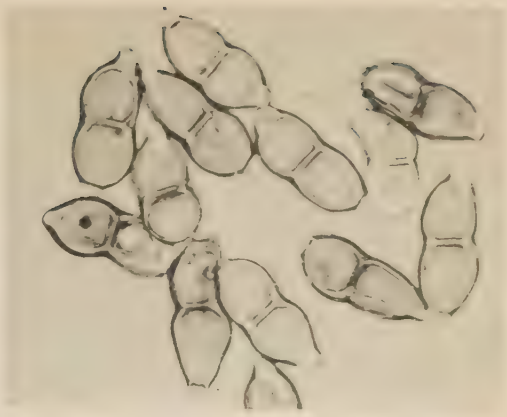
74d. Puccinia Heucherae (Schw.) Diet. On Saxifraga punctata. Utah. ×500.

74e. Puccinia Heucherae (Schw.) Diet. On Saxifraga granulata. Germany. ×500.

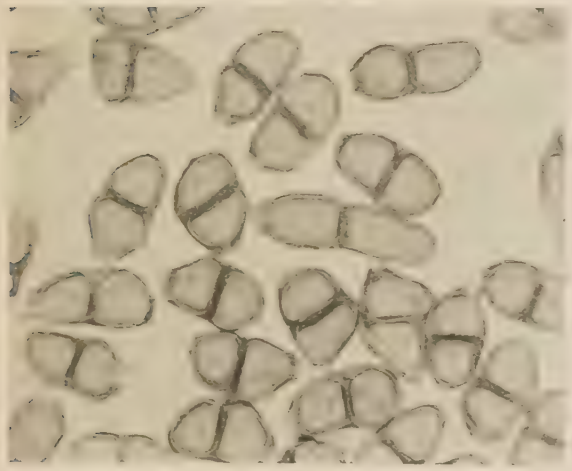
74f. Puccinia Heucherae (Schw.) Diet. On Saxifraga punctata. Wash. ×500.



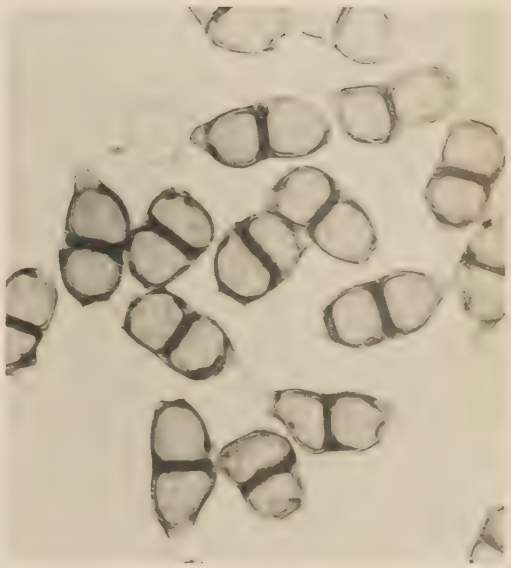
74a



74b



74c



74d

74e

74f

75a. Puccinia Lithophragmae Holw. On Lithophragma parviflora. Utah. ×250.

75b. Puccinia Lithophragmae Holw. On Lithophragma parviflora. Utah. ×500.

PLATE 21

Saxifraga. Heucherae. Mitella. Tellima. Tiarella. (Continued.)

No.

74g. Puccinia Heucherae (Schw.) Diet. On Saxifraga punctata. Wash. ×250.

74h. Puccinia Heucherae (Schw.) Diet. On Heucherae micrantha. Calif. (Puccinia congregata E. & H.) ×250.

74i. Puccinia Heucherae (Schw.) Diet. On Mitellla nuda. Mich. ×250.

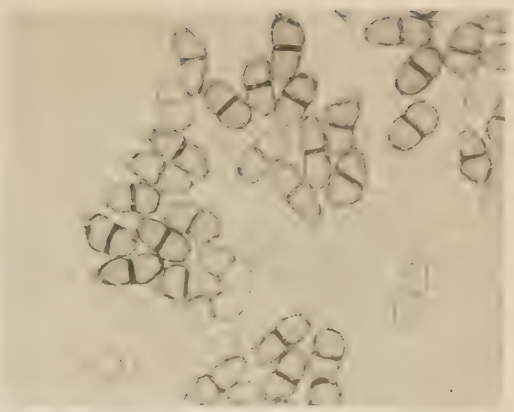
74j. Puccinia Heucherae (Schw.) Diet. On Tiarella cordifolia. Ellis. N. A. F. 1049. ×500.

Lithophragma.

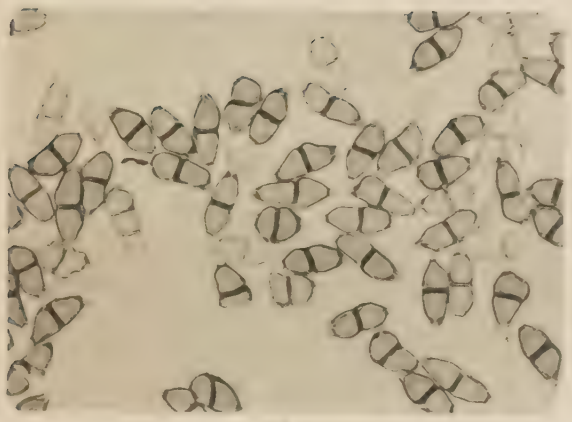
75a. Puccinia Lithophragmae Holw. On Lithophragma parviflora. Utah. ×250.

75b. Puccinia Lithophragmae Holw. On Lithophragma parviflora. Utah. ×500.

74g

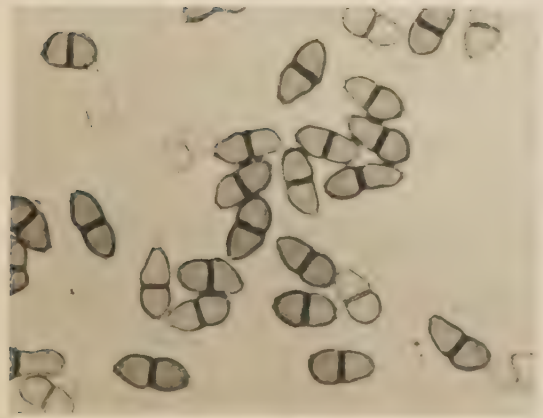


74h



74i

74j



75a

75b

PLATE 22

Tiarella.

No.

76a. Puccinia trifoliata E. & E. On Tiarella trifoliata. Wash. Type. ×250.

76b. Puccinia trifoliata E. & E. On Tiarella trifoliata. Wash. Type. ×500.

Parnassia.

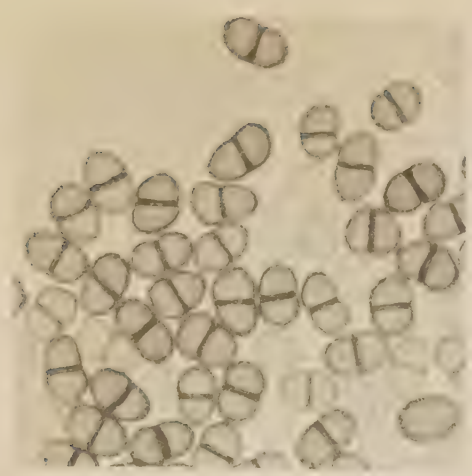
77a. Puccinia Parnassiae Arth. On Parnassia fimbriata. Canada. ×250. Type.

77b. Puccinia Parnassiae Arth. On Parnassia fimbriata. Canada. ×500. Type.

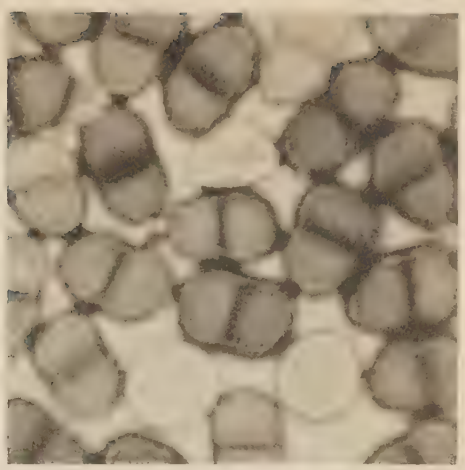
Ribes.

78. Puccinia Parkerae Diet. & Holw. On Ribes lacustris. Wash. ×250. Type.

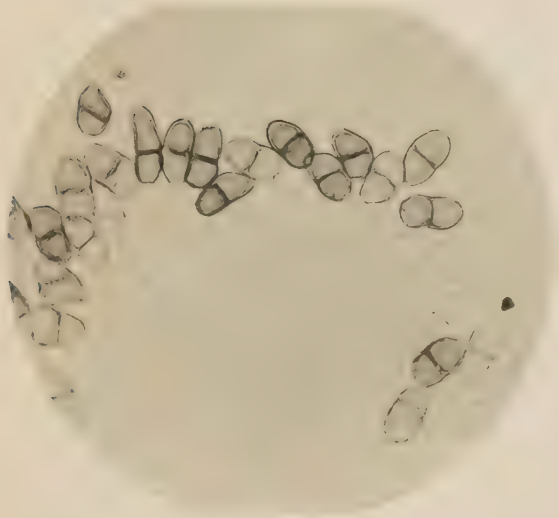
79a. Puccinia Ribis DC. On Ribes rubrum. Minn. ×250.



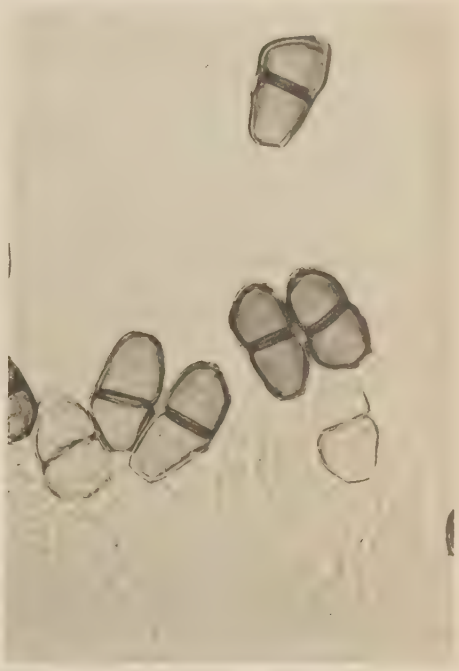
76a



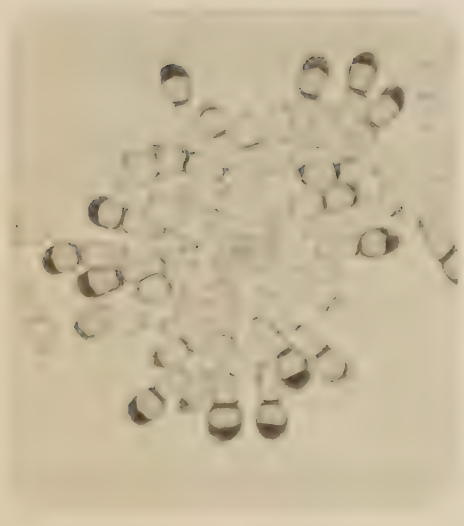
76b



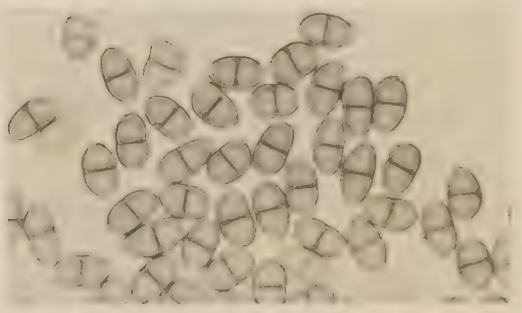
77a



77b



78



79a

PLATE 23

Ribes. (Continued.)

No.

79b. Puccinia Ribis DC. On Ribes rubrum. Mich. ×500.

79c. Puccinia Ribis DC. On Ribes petraeum. Switzerland. ×500.

CRASSULACEAE.

Sedum.

80. Puccinia Rhodiolae B. & Br. On Sedum roseum. Col. ×250.

ROSACEAE.

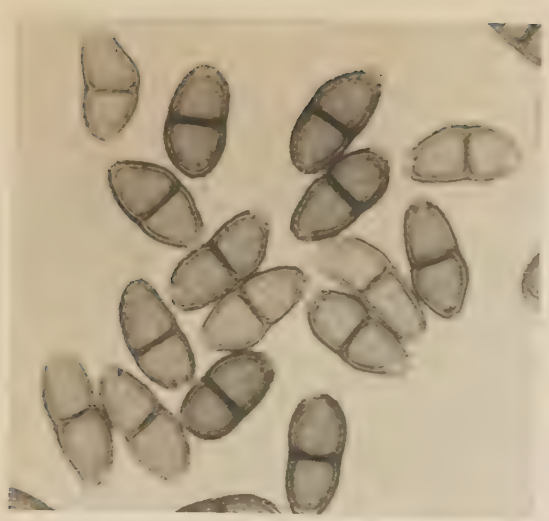
Sieversia.

81a. Puccinia Sieversiae Arth. On Sieversia turbinata. Utah. Type. ×250.

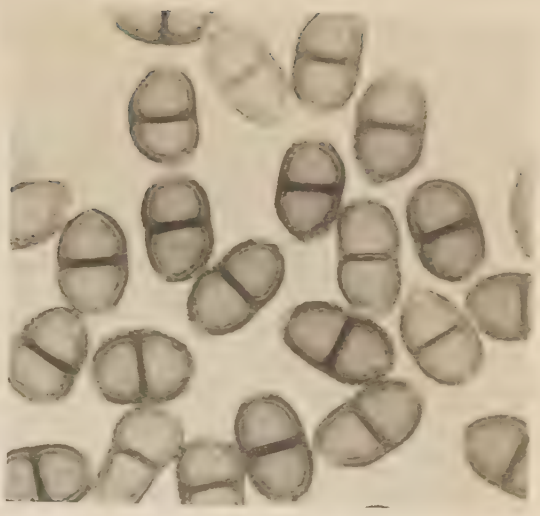
81b. Puccinia Sieversiae Arth. On Sieversia turbinata. Utah. Type. ×500.

Waldsteinia.

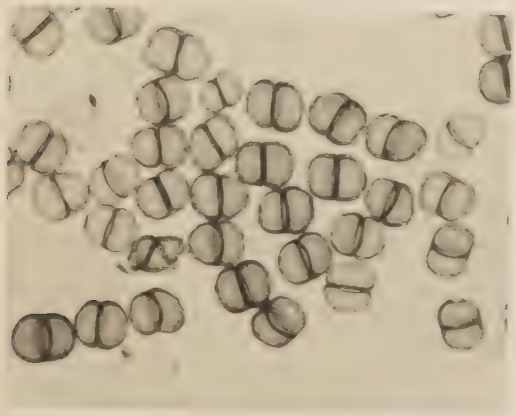
82. Puccinia Waldsteiniae Curt. On Waldsteinia fragarioides. N. Y. ×250.



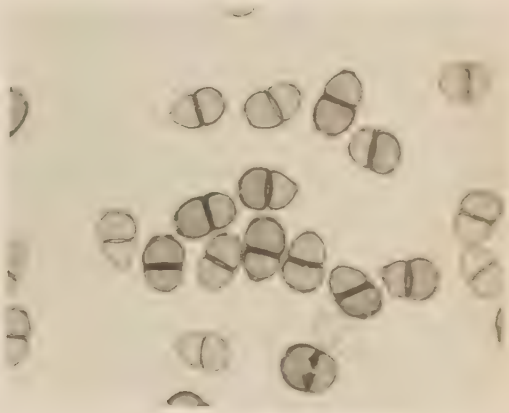
79b



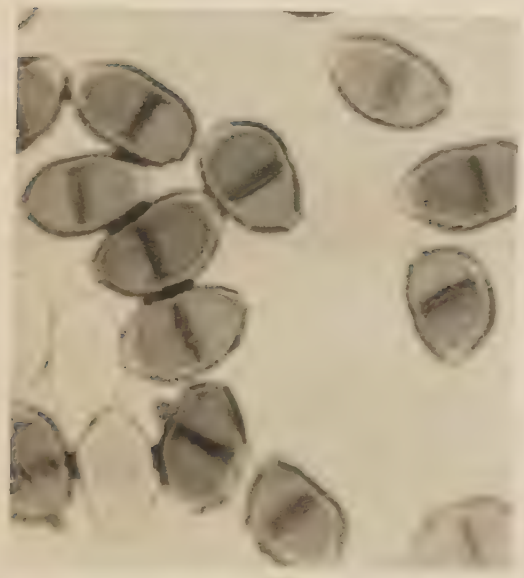
79c



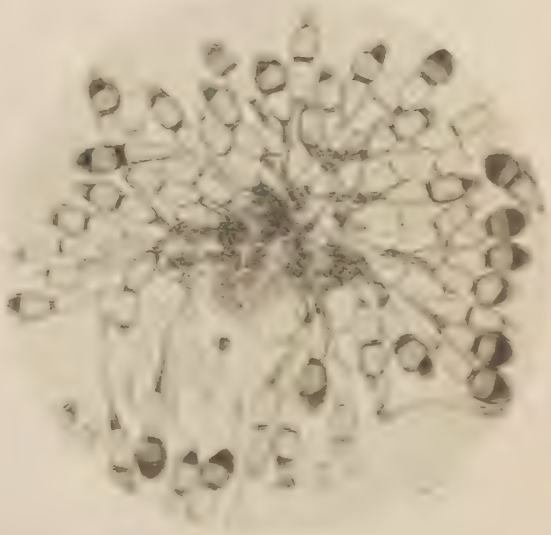
80



81a



81b



82

North American Uredineae

E. W. D. Holway

Vol. I. Part III.

Genus Puccinia.

Leguminosae, Geraniaceae, Oxalidaceae, Malpighiaceae, Polygalaceae, Euphorbiaceae, Sapindaceae, Balsaminaceae, Rhamnaceae, Tiliaceae, Malvaceae, Violaceae, Lythraceae, Onagraceae, Halorrhagidaceae

Minneapolis, Minnesota
Issued May 10, 1907

LEGUMINOSAE.

DOLICHOS.

Puccinia Dolichi Arth.

Bull. Torr. Bot. Cl. **33**:28. 1906.

The specimens from which this species was described have uredospores only. The supposed teleutospores were scattered upon the leaves by the collecting sheets which had been used in Mexico, and are those of Puccinia intumescens Holw. on Euphorbia calyculata.

GERANIACEAE.

GERANIUM.

84. Puccinia Leveillei Mont.

Gay, Hist. de Chile **8**:41. 1852.

Syn: Puccinia Geranii Lev. Ann. Sc. Nat. **5**:270. 1846.
(Not Puccinia Geranii Corda, Icones **4**:12. 1840.)
Puccinia semireticulata Fckl. Nass. Ver. f. Naturk. **29**:12. 1875.
Puccinia Fuckelii Koern. Hedw. **16**:20. 1877.
Puccinia Geranii-silvatici Karst. Helsinfors Faun. Fl. Fenn. Not. **8**:220. 1882.
Puccinia Leveilleana De Toni. Sacc. Syll. **7**:696. 1888.
Puccinia Geranii-silvatici himalensis Barclay. Ann. Bot. **5**:27. 1890.
Dicaeoma Geranii-silvatici Kuntze. Rev. Gen. Pl. 3^2:469.,1898.
Dasyspora Geranii-silvatici Arth. Result. Sc. Cong. Intern. d. Bot. 1905. :346. 1906.

III. Teleutosori mostly hypophyllous on red or yellow spots, at first covered by the epidermis, small, round, crowded, soon naked and pulverulent, confluent in large irregular groups, chestnut-brown; teleutospores brown, elliptical, rounded at both ends, apex not thickened, wall uniformly 2—3μ thick, strongly verrucose on the upper cell, tubercles less prominent on the lower cell, 24—36×16—28μ; germ-pore of the upper cell at the apex, that of the lower from the middle to near the pedicel, which is slender, hyaline, up to 60μ long, mostly with a septum about 8μ from the spore where it readily separates, leaving a short piece attached.

On Geranium incisum Nutt. Wash., G. Fremontii Torr. Utah; G. Richardsonii F. & M. Col. Utah; G. venosum Rydb. Utah.

Exsic: Garrett Fg. Utah. *88*. Vestergren Micromycetes *965*. Ellis & E. Fg. Columb. *1572*. Ellis & E. N. A. F. *2240*.

Photo: No. 84. On Geranium Fremontii. Utah; x500.

Type: Chile. "Esta Puccinia se encuentra las hojas del Geranium rotundifolium y fue hallada por Bertero (Colecc. No. 576) y por el senor Gay."

OXALIDACEAE

OXALIS.

85. Puccinia Oxalidis Diet. & Ellis.

Hedw. **34**:291. 1895.

Syn: Dicaeoma Oxalidis (Diet. & Ellis) Kuntze, Rev. Gen. Pl. 3^2:469. 1898.

II. Spots yellow, angular, often numerous; uredosori hypophyllous, orange when fresh, firm, small, scattered, or clustered in large round groups, rarely confluent; uredospores pale yellow, hyaline when dry, mostly globose, 16—18μ in diameter, rarely elliptical to oblong, 18—22×16—18μ, evenly and minutely verrucose.

III. Teleutosori firm, hypophyllous, pale yellow to white, small, irregular, confluent; teleutospores oblong or elliptical, hyaline, smooth, germinating at once, wall uniform, thin, rounded at both ends, septum often more or less diagonal, 18—30×13—16μ; pedicel hyaline, fragile, up to the length of the spore.

On Oxalis sp. Mexico. New Mex. Texas.

Exsic: Ellis & E. N. A. F. *2716.*
Photo: No. 85. From Oxalis sp. Mexico. x500. Cell contents stained.
Type: Mexico. "Auf Oxalis sp. leg. Dr. E. Palmer."
This is a very common species in Mexico.

MALPIGHIACEAE.

HETEROPTERYX.

86. Puccinia sanguinolenta P. Henn.

Hedw. **35**:228. 1896.

Syn: Puccinia rubricans Holway. Jour. Mycol. **10**:165. 1904.

II. Spots crimson, mostly round, 1—6mm. in diameter, many of the leaves having a few large spots and numerous scattered small ones; uredosori amphigenous, mostly hypophyllous, light brown, solitary, scattered, or clustered and circinate on the larger spots, small, pulverulent, surrounded by the ruptured epidermis; uredospores yellowish-brown, globose, rarely ovate, strongly echinulate, spines 3—4μ apart, wall 4—6μ thick, 36—44×32—36μ.

III. Teleutosori following in the uredosori, black; teleutospores from almost globose to broadly elliptical, wall 4—6μ thick, the epispore yellowish and swelling in lactic acid to 4μ thick, the inner spore dark reddish-brown, the two cells of the same shape and size, rounded at both ends, the epispore sometimes prolonged into a short point, 60—80×40—44μ; pedicel hyaline, fragile, up to 80μ long, colored next the spore, sometimes enlarged near the base.

On Heteropteryx Portillana Wats. Guadalajara, Mexico.

Photo: No. 86a. x250.
No. 86b. x500. Both from the Mexican specimen.
Type: Brazil. "Rio de Janiero auf Blättern von Myrcia sp. ?"

After the publication of Puccinia rubricans I ascertained that the host of Puccinia sanguinolenta was some species of Heteropteryx instead of Myrcia. See Ann. Mycol. **3**:24. 1905.

STIGMATOPHYLLON.

87. Puccinia inflata Arth.

Bull. Torr. Bot. Cl. **33**:516. 1906.

II. Uredosori amphigenous, small, roundish, scattered, or clustered and somewhat circinate, soon naked and pulverulent, surrounded by the ruptured epidermis when young; uredospores globose to ovate, cinnamon-brown, sparsely and sharply echinulate, 26—33×22—26μ; germ-pores 3—4, usually scattered, rarely equatorial.

III. Teleutosori amphigenous, small, roundish, mostly scattered, sometimes clustered, chocolate-brown, ruptured epidermis at first prominent, soon naked and somewhat pulverulent; teleutospores ellipsoid, 20—34×23—26μ, rounded at both ends, scarcely constricted at the septum, wall 4—5μ thick, sometimes slightly thicker opposite the pedicel, chocolate-brown, strongly reticulate; pedicel fragile, hyaline, often inserted more or less laterally, globosely enlarged next the spore, up to 50μ long.

On Stigmatophyllon periplocifolium (Desf.) Juss. Cuba.

Photo: No. 87a. From the type collection x250.
No. 87b. The same x500.
Type: Cuba. "Baracoa, Mch. 13. 1903. E. W. D. Holway."

This is much like the following species, but the uredosori are darker and the teleutosori lighter in color; the uredospores have fewer germ-pores, the teleutospores are borne on longer and more slender pedicels, are smaller, less globose, and much lighter colored.

ECHINOPTERYX.

88. Puccinia Echinopteridis Holw.

Jour. Mycol. **10**:164. 1904.

II. Spots pale yellow, round or irregular; uredosori light brown, mostly hypophyllous, small, circinate in small groups, globose to oblong, rarely confluent, ruptured epidermis prominent; uredospores globose to ovate, light brown, 26—33×22—26μ, strongly echinulate, spines about 3μ apart, germ-pores 8.

III. Teleutosori amphigenous, black, very pulverulent, small, scattered, rarely confluent; teleutospores globose to broadly elliptical, not constricted, wall nearly uniform in thickness, occasionally slightly thickened opposite the pedicel, rounded at both ends, cells of the same shape and size, dark reddish-brown,

nearly opaque, strongly reticulate, 30—44×22—37μ; pedicel about the length of the spore, hyaline, fragile, globosely inflated next the spore.

On Echinopteryx Lappula Juss. Mexico.

Exsic: Sydow Ured. *1870.*
Photo: No. 88a. x250.
No. 88b. x500.
No. 88c. x500. All from the type specimen.
Type: Mexico. "On Echinopteryx Lappula Juss. Guadalajara. No. 5036."

This closely resembles Puccinia insueta Wint., from which it varies in its entirely different uredospores and the stronger reticulations of the teleutospores. The germ-pores of the uredospores are difficult to make out but are certainly 8 in many.

POLYGALACEAE.

POLYGALA.

89. Puccinia Pyrolae Cooke.

Rep. N. Y. State Mus. **25**:119. 1873.

Syn: Puccinia Polygalae Pazschke. Rabh.—Wint. Fg. eur. *4029.* 1895.
Dicaeoma Pyrolae (Cke.) Kuntze, Rev. Gen. Pl. **3**²:470.1898.
Dasyspora Pyrolae Arth. Result. sc. Congres intern. de Bot. 1905. 347. 1906.

III. Spots pale yellow or none; teleutosori amphigenous, more abundant on the under side of the leaves, black, round to oblong, punctiform to ½mm. in diameter, more or less circinate in irregular groups or scattered and covering the leaves and stems, soon naked, firm; teleutospores smooth, dark brown, elliptical to obovate, slightly constricted at the septum, apex rounded or obtusely pointed, up to 8μ thick, lower cell rounded or narrowed to the base, 28—40×16—26μ; pedicel persistent, slightly tinted, about the length of the spore.

On Polygala paucifolia Willd. Minn. Conn. N. Y. N. H. Canada.

Exsic: Rabh.-Wint. Fg. eur. *4029*; Ellis N. A. F. *1039*; Seym. & E. Econ. Fg. *B17.*
Photo: No. 89. From the Minnesota specimen, x250.
Type: New York. "Leaves, petioles and stems of the flowering wintergreen, Polygala paucifolia. Bergen Swamp. *Clinton.* Sandlake and Portville."

EUPHORBIACEAE.

EUPHORBIA.

90. Puccinia intumescens Holway new comb.

Syn: Puccinia Euphorbiae intumescens Syd. Monogr. **1**:457. 1903.

I. Spots none or yellow and red, irregular; aecidia hypophyllous, small, scattered, or 1—6 together, yellow, peridia breaking irregularly, not reflexed; aecidiospores globose to elliptical, pale yellow, verrucose, 24—36×22—28μ.

III. Teleutosori following in the aecidia, but mostly on the upper side of the leaf opposite them, black, surrounded by the ruptured epidermis, very pulverulent; teleutospores oblong, dark reddish-brown, closely reticulate, the lower cell more or less narrowed to the pedicel, the upper cell prolonged into a conical point up to 12μ long, 52—80×26—36μ; pedicel tinted next the spore, up to 120μ long, persistent, without the basal inflation of the following species but sometimes with a swelling near the middle or in the lower half.

On Euphorbia calyculata H. B. K. Mexico.

Photo: No. 90. From specimens collected by Holway at Lake Patzcuaro. x250.
Type: "Lake Patzcuaro, Mexico, (Pringle). In foliis vivis Euphorbia calyculatae."

This was very abundant on the mountain slopes near the Lake. A careful search was made for uredospores in different years but they do not occur. Numerous collections of Puccinia Euphorbiae have been made in different seasons and all are without aecidia.

91. Puccinia Euphorbiae P. Henn.

Bull. Herb. Boiss. **1**:109. 1893. Mch.
Engler Bot. Jahrb. **17**:13. 1893. May.

Syn: Puccinia Euphorbiae minor Diet. & Holw. Bot. Gaz. **24**:31. 1897.
Dicaeoma Euphorbiae Kuntze, Rev. Gen. Pl. **3**^{2}:468. 1898.
Puccinia Euphorbiae longipes Syd. Ured. Exsic: *1521*:1901.

II. Spots pale yellow, becoming brown with age, irregular in shape and size; uredosori mostly hypophyllous, ocherous, small, scattered, surrounded by the ruptured epidermis, firm; uredospores globose, ovate, or elliptical, pale yellowish-brown, sharply echinulate, wall about 4μ thick, germ-pores numerous, (12?), 28—36×24—36μ.

III. Teleutosori following in the uredosori, small, black, pulverulent, often confluent in groups up to 10mm. in diameter, surrounded by the ruptured epidermis; teleutospores reddish-brown, elliptical to oblong, apex in most specimens prolonged into a light colored rostrum 8—14μ in length, occasionally more or less rounded, not constricted at the septum, closely and evenly verrucose, the tubercles nearly round and quite uniform in size, frequently with a brown ring-like extension at the base through which the pedicel passes, rounded at both ends, 40—78×24—45μ; pedicel hyaline or tinted next the spore, up to 55μ long, often globosely inflated at the base.

On Euphorbia cotinifolia L., E. scotana Boiss., and various undetermined shrubby species of Euphorbia. Mexico. Common.

Exsic: Sydow Ured. *1521*. *1871*. *1872*.
Photo: No. 91a. From Euphorbia scotana. Jalapa, x250.
No. 91b. From the same x500.
Type: Abyssinia. "Col. Eritrea, valle Baresa in foliis vivis Euphorbiae Eritreae Schweinf. 29.11. 1892."

The different collections vary considerably in the length of the teleutospores.

SAPINDACEAE.

SERJANEA. CARDIOSPERMUM

92. Puccinia Arechavaletae Speg.

Ann. Soc. Cient. Arg. **11**:—(*22*). 1882.

Syn: Puccinia Serjaneae E. & E. Erythea **5**:6. 1897.
Dicaeoma Arechavaletae (Speg.) Kuntze. Rev. Gen. Pl. **3**²:467. 1898.

III. Spots conspicuous, yellow, becoming brown with age, irregular; teleutosori firm, dark brown, the center often grey with the sporidia of the germinating spores, small, densely crowded and confluent in round or irregular groups up to 10mm. in diameter, or scattered quite thickly over the leaves in small round clusters more or less circinate and distinct; teleutospores smooth, brown, wall uniformly 2—3μ thick; two-celled teleutospores elliptical, rounded at both ends, 20—32×14—26μ; one-celled teleutospores globose, elliptical, or ovate, 16—28×16—20μ; pedicel slightly tinted next the spore, persistent, up to 60μ long.

On Cardiospermum Halicacabum L. Mexico, Fla; C. microcarpum HBK. Mexico. Fla.; Serjanea racemosa Shuttlw. Mexico.

Photo: No. 92. From Cardiospermum Halicacabum, Mexico. x250.
Type: Argentina. "Ad folia viva Cardiospermi velutini propre Montevideo leg. Cl. J. Arechavaleta, et propre Quilmes, Jul. 1881."

BALSAMINACEAE.

IMPATIENS.

93. Puccinia argentata (Schultz) Wint.

Rabh. Krypt. Fl. **1**:194. 1884. Ed. 2.

Syn: Aecidium argentatum Schultz,, p. p. Prod. Fl. Starg: 454. 1806.
Caeoma impatientis Link. *Handb. **3**:439. 1833.
Caeoma apiculosum Link, p. p. Linne Sp. Pl. **6**²:32. 1825.
Puccinia nolitangeris Cda. Icones **4**:16. 1840.
Uredo impatientis Rabh. Krypt. Fl. **1**:5. 1844. Ed. 1.
Puccinia papillata Bon. p. p. Abhandl. d. Nat. Ges. Halle **5**:219. 1860.
Dicaeoma argentatum Kuntze, Rev. Gen. Pl. **3**²:467. 1898.

II. Spots none or pale yellow; uredosori hypophyllous, ocherous, scattered, round, rarely confluent; uredospores pale yellow, mostly globose, minutely echinulate, 20—22μ in diameter, germ-pores 4—7, mostly 6.

III. Teleutosori hypophyllous, brown, small, scattered, soon naked and pulverulent, not often confluent; teleutospores light brown, smooth, elliptical or ovate, rarely oblong, rounded at both ends, occasionally narrowed from the septum, wall of uniform thickness, 20—36×16—20μ; germ-pore of the upper cell at the apex or a little to one side, that of the lower cell from near the sept-

um to one-third down, each with a prominent globose hyaline papilla; pedicel fragile, hyaline, about the length of the spore.

On Impatiens biflora Wahl. I. aurea Muhl. Ia. Minn. Ills. West Va.

Exsic: Rabh.-Wint. Fg. eur. *4117*; Ellis N. A. F. *251*; Sydow Ured. *760*.
Photo: No. 93. From Impatiens aurea, Decorah, Ia. x500.
Type: Germany. "Habitat in foliis languescentibus Impat. Noli tangere. Septembre."

Bubak gives the germ-pores as 3—5, with the normal number as 4. He has also made cultures showing that the European Puccinia argentata has its aecidial stage on Adoxa moschatellina and that the mycelium is perennial. At Decorah, Ia., an isolated aecidium occurs on Adoxa with the Puccinia on Impatiens, but infected plants sent Dr. Arthur were free from the fungus the following year.

Bubak describes the aecidium as follows:

"Mycel perenniert in dem Wurzelstock und dringt im Frühjahre schnell durch die Blattstiele oder durch den Stengel, die dabei schwach verdickt werden, in die Blattspreiten, welche sich gelblichweiss verfarben und ebenfalls fleischiger werden. Bei frischer Infektion dringt das Mycel allmählich wieder umgekehrt aus Blattspreiten durch den Blattstiel oder den Stengel in den Wurzelstock, wobei wieder dieselben Verdickungen der befallenen Partien zustande kommen. Pykniden klein, 100—180μ breit, honiggelb, zwischen den Aecidien auf der Unterseite der Blätter zerstreut.

Pseudoperidien auf der Unterseite der Flecken ziemlich gleichmässig verbreitet, an den Blattstielen und Stengeln entfernter, weiss, anfangs halbkugelig gewölbt, durch ein zentrales rundliches Loch sich öffend, endlich mit ziemlich breit umgeschlagenem, tief zerschlitztem Rande, ¼—½mm im durchmesser. Pseudoperidienzellen in fast regelmässigen Längsreihen, im Zusammenhange von eckigem oder länglichem Umriss, mit feinwarziger, hyaliner Membran, auf den Aussenseite 7—11μ verdickt, daselbst von stäbchenförmiger Struktur.

Sporen polygonal-eiförmig, 17.6—22μ lang, 13.2—19.8μ breit, mit hyaliner, feinwarziger Membran und goldgelbem Inhalt."

The aecidium of Puccinia albescens also occurs on Adoxa in Europe, but it is distinguished by its colorless aecidiospores.

RHAMNACEAE.

RHAMNUS.

94. Puccinia Mesnieriana Thuem.

Mycoth. Univer. 9:*834*. 1877.
(Description on the label.)
Flora **61**:93. 1878.
Lisboa Jour. Sci. Math. **6**:238. 1878.

Syn: Puccinia digitata Ell. & Hark. Bull.. Calif. Acad. Sc. **1**:27. 1884.
Dicaeoma Mesnierianum Kuntze. Rev. Gen. Pl. **3²**:469. 1898.
Dasyspora Mesnieriana Arth. Result. Sc. du Cong. Intern. de Bot. 1905:347. 1906.

III. Spots round, brown, occasionally depressed; teleutosori mostly hypophyllous, black, pulvinate, firm, surrounded by the ruptured epidermis, scattered, round, or elongated and confluent along the veins, ¾—4mm in diameter;

teleutospores smooth, brown, clavate, apex dark brown, thickened and with 2—7 blunt processes, constricted at the septum, upper cell mostly shorter and broader than the lower, which is narrowed to the base, 44—76×12—18μ; pedicel the color of the spore, up to 28μ long.

On Rhamnus crocea Nutt., R. illicifolia Kellogg. Calif.

Exsic: Syd. Ured. *1375*; Ellis, N. A. F. *1466*; Arth, & Holw. Ured. Exsic. *13*.
Photo: No. 94. From Rhamnus crocea. Calif. x250.
Type: Portugal. "Coimbra ad Rhamni Alaterni Lin. folia viva. Julio 1876. Raro. leg. P. G. Mesnier."
See note under number 78.

TILIACEAE.

TRIUMFETTA.

95. Puccinia Triumfettae Diet. & Holw.

Bot. Gaz. **24**:30. 1897.

III. Spots round or irregular, dark brown, with a yellow margin; teleutosori hypophyllous, brown, pulvinate, in small irregular groups, the central sorus often germinating; teleutospores elliptical to oblong, pale yellowish-brown, smooth, only slightly or not at all constricted at the septum, apex rounded, 3—7μ thick, wall about 2μ thick, sometimes thinner in the lower cell which is a little narrowed towards the base, 24—36×12—18μ; pedicel hyaline, persistent, up to 90μ long.

On Triumfetta semitriloba Linn. Cuernavaca, Mexico, Holway.

Photo: No. 95. From the type specimen. x500.
Collected in a deep shady barranca in one locality only, in 1896, 1899 and 1903.

MALVACEAE.

SIDA. MALVASTRUM. ALTHAEA.

96. Puccinia lobata B. & C.

Grev. **3**:54. 1874.

Syn: Dicaeoma lobatum Kuntze. Rev. Gen. Pl. **3**²:469. 1898.

III. Spots irregular, yellowish; teleutosori firm hypophyllous, scattered, small, dark brown, in round groups 1½—2mm in diameter, often confluent, with the central sorus germinating; teleutospores smooth, elliptical to obovoid, chestnut-brown, apex slightly thickened, often breaking into a few irregular points in germinating, mostly 32—40×22—26μ; pedicels persistent, hyaline, up to 120μ long.

On Sida lepidota A. Gray, Malvastrum sp., Texas; Sida hederacea (Dougl.) Torr. Calif.; Althaea rosea Cav. Mexico.

Exsic: Tracy, Plants Gulf States *8264*.
Photo: No. 96a. From Althaea rosea, Mexico, x250.
No. 96b. From the type specimen.
Type: Texas. "On Sida lepidota, C. Wright No. 6400."

This has been referred to Puccinia heterospora B. & C., from which it differs in its regularly inserted pedicels and very few one-celled teleutospores.

Some very large and very small teleutospores occur, as is frequently the case in other species on malvaceous hosts.

SIDA. ABUTILON.. ANODA.

97. Puccinia heterospora B. &. C.

Jour. Linn. Soc. **10**:356. 1868.

Syn: Uromyces Thwaitsii B. & Br. Jour. Linn. Soc. **14**:92. 1875.
Uromyces pulcherrimus B. & C. Grev. **3**:56. 1874.
Uromyces Sidae Thuem. Rev. Mycol. **1**:10. 1879.
Uromyces Malvacearum Speg. Ann. Soc. Cient. Arg. **11**:27. 1882.
Puccinia Thwaitsii Wint. Hedw. **22**:130. 1883.
Puccinia heterospora pulcherrima Lagerh. Tromso Mus. Aarsheft. **17**:—(61.) 1895.
Dasyspora heterospora Arth. Resultats sc. du Cong. intern. de Bot. 1905:346. 1906.

III. Spots yellow, or brown with yellow margin, orbicular or irregular; teleutosori more frequently hypophyllous, but often amphigenous, dark brown, small, firm, scattered or confluent in circular groups of variable size; two-celled teleutospores few, nearly absent in some specimens, elliptical to globose, smooth, brown, apex, or the side opposite the pedicel, slightly thickened, from 20x16 to 36x28μ; one-celled teleutospores subglobose to ovate, thickened at the apex, 16-32μ in diameter; pedicel hyaline, slender, persistent, up to 120μ long, often inserted laterally.

On many species of Abutilon, Anoda, and Sida, from Illinois south, especially in Mexico and Cuba.

Exsic: Pringle Mex. Fg. *1. 2.* Roum. Fg. sel. *4407*; Seym. & E. Econ. Fg. *269. 269a.*
Ellis N. A. F. *2413*; Fg. Columb. *1455*; Rabh.-Wint. Fg. eur. *3121. 4123.*
Carleton Ured. Am. *48.*
Photo: No. 97. From Abutilon Holwayi, Mexico. x250.
Type: Cuba. "On the leaves apparently of some malvaceous plant."

MALVASTRUM. SIDALCEA. SPHAERALCEA. ALTHAEA.

98. Puccinia Sherardiana Koern.

Hedw. **16**:19. 1877.

Syn: Puccinia Malvastri Peck. Bull. Torr. Bot. Cl. **12**:35. 1885.
Dicaeoma Malvastri Kuntze, Rev. Gen. Pl. **3**²:469. 1898.
Dicaeoma Sherardianum Kuntze, l. c. :470.
Dasyspora Sherardiana Arth. Resultats sc. Cong. intern. Bot. 1905;347. 1906.

III. Teleutosori dark brown, mostly hypophyllous, firm, pulvinate, round, ½-1mm in diameter, soon confluent, often thickly covering the leaves; teleutospores smooth, yellowish-brown, oblong-elliptical to oblong, wall 4μ thick, apex mostly rounded, sometimes obtusely pointed, not at all or somewhat thickened, slightly constricted at the septum, often germinating in the sorus, 36—64×20—32μ; pedicel persistent, hyaline, up to 300μ long.

On Malvastrum coccineum Gray. S. Dak., N. Dak., Col., Kans., Mont., Texas, Canada; Malvastrum Thurberi Gray, M. splendens Kellogg, Sidalcea spicata Greene, S. malvaeflora (Moc. & Sesse) Gray, Calif.; Sphaeralcea Munroana (Dougl.) Spath. Wash. Idaho; S. angustifolia Don. New Mex. Mex.; Malvastrum sp. Utah. Calif.; Althaea rosea Cav. Calif.

Exsic: Sydow Ured. *775. 1276*; Baker Pls. Pac. Slope *3289. 4197*; Seym. & E. Econ. Fg. *B16*; Griffiths West Am. Fg. *24*; Rabh.-Wint. Fg. eur. *3515*; Carleton Ured. *2*; Ellis, N. A. F. *3478. 1850a. 1850b*; Earle Pls. New Mex. *229*; Heller Idaho Pls. *3249*.

Photo: No. 98a. From Malvastrum Thurberi, Calif. x250.
No. 98b. From Malvastrum coccineum, Canada, x250.
No. 98c. From Althaea rosea, Calif. x250.
No. 98d. From Sidalcea malvaeflora, Calif. x250.
No. 98e. From Malvastrum sp. Calif. x250.
No. 98f. From Malvastrum coccineum, Kans. x250.
No. 98g. From Sphaeralcea angustifolia, New Mex. x250. Type of Puccinia Sphaeralceae E. & E.

Type: Armenia. "In foliis Malvae Sherardianae L. leg. Szovits."

The type could not be obtained for examination, but the description indicates that it is our species. Puccinia Sphaeralceae, in the type collection, had an aecidium on the leaves with the Puccinia but this was accidental without doubt. I have collected it in abundance in New Mex., and no trace of an aecidium could be found.

Puccinia Malvastri is an exceedingly variable species and much like the ungerminated forms of Puccinia Malvacearum; the teleutospores are however mostly broader and the pedicels are much longer. The spores often exhibit remarkable differences even in the same sorus as shown in photograph No. 98f.

ALTHAEA. MALVA. LAVATERA. MALVASTRUM.

99. Puccinia Malvacearum Bertero.

Gay, Hist. de Chile **8**:43. 1852.

Syn: Dicaeoma Malvacearum Kuntze, Rev. Gen. Pl. **3**²:469. 1898.
Dasyspora Malvacearum Arth. Resultats sc. du Cong. intern. de Bot. 1905: 347. 1906.

III. Teleutosori scattered, often thickly covering the leaf, round, pulvinate, firm, naked, usually grey with the sporidia of the germinating spores, the unger-

minated sori brown to reddish-brown; teleutospores oblong to oblong fusiform, rarely somewhat elliptical, smooth, light yellow, except in the ungerminated sori where they are brown and extremely variable in shape and size, slightly constricted at the septum, apex from acute to slightly rounded, not at all or strongly thickened, the two cells of the same shape and size and narrowed each way from the septum, 36—72×16—28μ; pedicel variable in length, hyaline, persistent, up to 150μ long.

On many species of Althaea, Lavatera and Malva, in nearly all parts of the U. S.

On Malvastrum sp. Mexico; Malvastrum coromandelinum (L.) Garcke. Cuba.

Exsic: Seym. & E. Econ. Fg. *1.267*; Arth. & Holw. Ured. Exsic. 15; Ellis & E. Fg. Columb. *1766*; Kellerman Ohio Fg. *31*.

Photo: 99a. From Althaea rosea, Ohio Fg. 31. x250. Partially germinated.
99b. From Althaea rosea, Wash. x250. Ungerminated.
99c. From Malvastrum sp. Mexico. x250. Mostly germinated.

Type: Chile. "Bertero hallo esta linda especie en differentes especies de malvaceas, en donde es muy comun."

This species soon spread all over the world. It was found in Australia in 1857, in Spain in 1869, and in Germany, France and England in 1873.

Sydow says: "Ein besondere Interesse beansprucht ausserdem diese Art insofern, als sie die Fähigkeit besitz, auf verschiedenen Malvaceen-Gattung zu leben, dass sie nicht an eine Gattung gebunden ist. In den botanischen Gärten, wo Althaea-Malva-,Lavatera-, etc. Arten beisammen stehen, wird man oft sämtliche Pflanzen von Puccinia Malvacearum infiziert finden. Diese Art ist noch heut zu Tage sehr plurivor."

This is true in this country, as Mr. Blasdale has sent many specimens from the Botanical Gardens at Berkeley, Calif.

SIDALCEA.

100. Puccinia Sidalceae Holway n. sp.

III. Spots purple, irregular; teleutosori hypophyllous, long covered by the epidermis, which remains prominent, round to oblong, scattered or more or less circinate in small groups, firm, light yellow when young, dark brown at maturity; teleutospores elliptical, varying greatly in size, light yellow when young, the mature spores intermixed and dark reddish-brown, the two cells of the same shape and size, rounded at both ends, apex not thickened, wall of upper cell often 4—6μ thick, gradually becoming thinner towards the pedicel, mostly smooth, rarely with a few short blunt projections, from 32×20 to 56×36μ; pedicel fragile, hyaline, up to 120μ long.

On Sidalcea Oregana (Nutt.) Gray. Klamath Co. Oregon.

Exsic: Sydow Ured. *1782*.
Photo: No. 100. x250.

VIOLACEAE.

VIOLA.

101. Puccinia ornatula Holway n. sp.

III. Spots pale yellow, irregular or none; teleutosori hypophyllous, round, brown, punctiform to ⅓mm in diameter, surrounding epidermis prominent and

persistent, occasionally confluent along the veins up to 15mm in length; teleutospores brown, elliptical to oblong, often somewhat irregular, both cells alike and rounded or one or both narrowed from the septum, wall thin (2μ and less), uniform, smooth except for 2—4 rows of tubercles which are mostly longitudinal; germ-pore of the upper cell at the apex or more or less to one side, that of the lower cell from close to the septum to the middle, each with a globose hyaline papilla, 24—40×16—22μ, with a few spores smaller and larger; pedicel fragile, hyaline, about the length of the spores.

On Viola (Canadensis?) Alpine meadow, Glacier, B. C.

Photo: No. 101a. Showing tubercles, x500.
No. 101b. x500.

This is the collection referred to Puccinia alpina in Sydow's Monograph, a species not yet found in N. Am., and which is very different, having more regular teleutospores covered with strong reticulations. It has also been referred to Puccinia effusa, from which it differs in every way. The sori of Puccinia ornatula are distinct, the epidermis surrounding them like a cylinder and not breaking into fragments.

102. Puccinia Fergussoni B. & Br.

*Ann. Nat. Hist. **15**:35. 1875.

Syn: Puccinia nidificans Magn. Hedw. **14**:20. 1875.
Dicaeoma Fergussoni Kuntze. Rev. Gen. Pl. **3**²:468. 1898.
Dasyspora Fergussoni Arth. Resultats sc. du Cong. intern. 1905. 346. 1906.

III. Spots yellow, teleutosori mostly hypophyllous and on the petioles, sparingly epiphyllous, brown, small, crowded, soon naked and confluent, pulverulent, forming round or irregular groups up to 8mm in diameter; teleutospores smooth, brown, oblong, more or less angular and irregular, constricted at the septum, apex round, angular or acute, up to 6μ thick, 26—44×12—18μ; pedicel hyaline, fragile, about the length of the spore.

On Viola blanda L. Utah; V. Langsdorfii Fisch. Canada; V. palustris L. N. H.

Exsic: Garrett Fg. Utah *53*.
Photo: No. 102. From the Utah specimen. x500.
Type: Scotland. "On leaves of Viola palustris. New Pitsligo, Rev. J. Fergusson."

103. Puccinia Canadensis Arth.

Bull. Torr. Bot. Cl. **31**:2. 1904.

Syn: Dasyspora Canadensis Arth. Resultats sc. Cong. intern. Bot. 1905:346. 1906.

III. Sori amphigenous, chestnut-brown, small, round or oblong, surrounded by the ruptured epidermis, soon confluent, pulverulent; teleutospores brown, mostly oblong-linear, rarely elliptical, strongly constricted at the septum, wall uniformly 2μ thick, apex rounded or obtusely pointed, sometimes slightly thickened and nearly hyaline, lower cell mostly narrowed to the base, minutely verrucose, the tubercles in irregular longitudinal rows, 28—56×12—16μ; pedicel delicate, hyaline, fragile, up to 40μ long.

Puccinia alpina Fckl. x500.
From Sydow Ured. 1055.

On Viola orbiculata Geyer. Glacier, Laggan and Yoho Valley, Canada.

Photo: No. 103. x500. From the type collection.
Type: Canada. "On Viola orbiculata Geyer, Laggan, Alberta, Aug. 23, 1902."

104. Puccinia effusa Diet. & Holw.

Erythea **3**:81. 1895.

Syn: Allodus effusa Arth. Resultats sc. du Cong. intern. de Bot. 1905. 345. 1906.

O. I. Spermogonia pyriform, amber colored, scattered over the leaves and petioles in connection with the teleutospores or more often between the clusters of aecidia, 150—200μ in diameter; spermatia 4—8×2—3μ; aecidia amphigenous but mostly hypophyllous, in large irregular clusters, covering the petioles and following the veins of the leaf, broad, low, margin white, scarcely reflexed, irregularly lacerate; aecidiospores globose, elliptical, or more or less angular, 20—30×20—25μ.

II. Uredosori none; uredospores few, intermixed with the teleutospores, globose to elliptical, brown, coarsely echinulate, wall 4—5μ thick, 20—35×20—28μ, germ-pores 2—3.

III. Teleutosori following in and around the aecidia, more rarely on separate leaves, amphigenous, dark brown, nearly black, punctiform to 1mm in diameter, at first covered by the epidermis which remains quite prominent, finally becoming pulverulent and occasionally confluent; teleutospores dark brown, broadly elliptical to oblong, varying greatly in size, seldom constricted at the septum, usually rounded at both ends, sometimes more or less angular, wall uniformly 3½—4μ thick, strongly verrucose, 32—57×23—30μ; germpore of the upper cell at the apex or to one side, that of the lower cell mostly near the septum, rarely to one-third of the distance down, each covered with a large light colored papilla; pedicel hyaline, fragile, up to the length of the spore.

On Viola lobata Benth. Dunsmuir, near Sisson, Calif.; Viola ocellata Pursh. Ukiah, Calif.; Viola Nuttallii Pursh. Klickitat Co. Wash.

Photo: No. 104a. From the type x500.
No. 104b. From Viola Nuttallii x500.
No. 104c. From Viola ocellata x500.
No. 104d. From Viola ocellata x500.
Type: California. "On Viola lobata. Dunsmuir, May, 1894. leg. Holway."

The description above applies to the type specimen only. Two collections on Viola Nuttallii have been seen, one made in May, 1897, and the other in Sept., 1894, both by Suksdorf. The latter has teleutospores only, which are very regular in size and shape, broadly elliptical, 28—40×24—32μ; the former has aecidia and teleutospores as in the type. There are no uredospores in either collection.

The one on Viola ocellata was referred here by Dr. Dietel in the description of the species. Later Dr. Arthur in revising the Violet Rusts of N. Am. placed it under Puccinia Violae on account of the uredospores. The spores however cannot be distinguished from those of Puccinia effusa, as will be seen by reference to the photographs, and the dark brown teleutospores with thick walls separate it readily from any specimen of Puccinia Violae yet seen. Two forms occur in this collection, one with aecidia and teleutospores, with uredospores intermixed, and the other with abundant uredosori and teleutosori, all from the same plants. The uredosori are light brown, pulverulent, minute, scattered quite evenly over the leaf, with uredospores as in the type.

The type material is abundant and more than 100 slides were examined, so that the presence of uredospores is beyond question, one to twelve occuring in nearly every slide. More abundant collections are necessary for the full elucidation of the species.

105. Puccinia Violae (Schum.) DC.

Fl. Fr. **6**:62. 1815.

Syn: Aecidium Violae Schum. Pl. Saell. **2**:224. 1803.
Uredo Violae Schum. l. c. :233.
Aecidium Violarum DC. Fl. Fr. **2**:240. 1805.
Puccinia Violarum Lk. Linne, Sp. Pl. **6**²:80. 1825.
Puccinia hastata Cke. Grev. **3**:179. 1875.
Puccinia Fergussoni hastatae De T. Sacc. Syll. **7**:682. 1888.
Puccinia densa Diet. & Holw. Hedw. **36**:298. 1897.
Dicaeoma Violae Kuntze, Rev. Gen. Pl. **3**²:471. 1898.

O. I. Spermogonia preceding or accompanying the aecidia, amphigenous, honey-yellow, 100—150μ in diameter; spermatia eliptical or subglobose, 4—7×3—5μ; aecidia hypophyllous, covering large areas of the leaf and petiole, or in irregular clusters, crowded, low, broad, margin reflexed and divided into few divisions; aecidiospores subglobose, elliptical or angular, minutely and evenly verrucose, 16—26×16—20μ, wall thin.

II. Uredosori mostly hypophyllous, at first in small groups on discolored spots, later sparsely and indefinitely scattered, soon naked and pulverulent, cinnamon-brown; uredospores globose to elliptical, sharply echinulate, yellowish-brown, wall varying from thin to thick, 20—33×18—25μ; germ-pores mostly 2, sometimes 3.

III. Teleutosori chocolate-brown, mostly hypophyllous, although in many specimens equally covering both sides of the leaf, small, round, scattered, soon naked and pulverulent, little confluent; teleutospores yellowish-brown, broadly elliptical, oblong or irregular, slightly or not at all constricted at the septum, from barely punctate to strongly verrucose, apex rounded or obtusely pointed, wall uniformly thick, germ-pore of the upper cell at the apex, that of the lower mostly at the septum, rarely somewhat depressed, each covered with a rather broad, low, light colored papilla, mostly 25—40×18—25μ, rarely up to 48μ long; pedicel hyaline, fragile, short or up to the length of the spore.

On many species of Viola throughout the U. S. and Canada and in Southern Mexico.

Exsic: Sydow Ured. *1184. 1520. 1618. 1784. 1833*; Ellis N. A. F. *254. 2411*; Ellis & E. Fg. Columb. *2075*; Seym. & E. Econ. Fg. *456*; Kellerm. Ohio Fg. *96. 132. 155*; Heller, Pls. Wash. *4066*; Garrett Fg. Utah. *48* ~~Carleton Ured. Am. 28.~~

Photo: 105a. From Viola canina, Sisson, Calif. x500.
105b. The same x500.
105c. From Viola primulaefolia, Maine, x500.
105d. From Viola glabella, Wash., type of Puccinia densa D. & H. x500.
105e. From Viola Rydbergii, Utah, x500.
105f. From Viola sp. Wyo. x500.
105g. From Viola sp. Glacier, B. C. x500.

105h. From Viola sp. Seym. & E. Econ. Fg. 456c. Vermont. x500.
105i. From Viola cognata, Sisson, Calif. x500.
105j. From Viola Canadensis, Cloudcroft, New Mex. x500.

Type: Aecidium. Island of Zealand, Denmark. "Congestum in foliis solitare & sparsum in petiolis Violae caninae."
Puccinia. France. "La Puccinia nait a la surface inférieure des feuilles de la violette hérissée."

This is an exceedingly variable species. In Europe the teleutospores measure only 21—32 × 17—21μ and are smooth or only slightly punctate when examined dry. Figures 105a and 105b represent nearly the typical form, being only slightly larger. The specimens on Viola Rydbergii, figure 105e, were distributed as Puccinia effusa, but that species has thick-walled teleutospores much darker in color. The leaves examined have aecidia and teleutospores with a few uredospores intermixed. Figure 105f, from specimen collected at Sheridan, Wyoming, by T. A. Williams, has the same teleutospores and quite abundant uredospores. Many western specimens have prominent tubercles and are usually much more variable in size and shape than the eastern ones. There may be more than one species included here, but until more ample collections of the mountain forms can be studied it is impossible to attempt any satisfactory separation.

LYTHRACEAE.

CUPHEA.

106. Puccinia Jaliscensis Holw.

Ann. Mycol. **2**:393. 1904.

Syn: Dasyspora Jaliscensis Arth. Resultats sc. du Cong. intern. de Bot. 1905: 347. 1906.

III. Teleutosori very small, on red and yellow spots, mostly hypophyllous, in groups up to 5mm in diameter, a cluster 8mm in diameter containing 12—15 sori, seldom confluent, surrounded by the ruptured epidermis, reddish-brown; teleutospores germinating at once, ochroleucous, smooth, oblong, clavate, or linear, apex acute, rarely rounded, 4—8μ thick, lower cell narrowed to the base, often more or less irregular, strongly constricted at the septum, 44—74×15—19μ; pedicel the color of the spore, up to 45μ long.

On Cuphea Hookeriana Walp., C. cyanea DC., C. nitidula HBK., C. squamuligera Koehne. Mexico.

Photo: No. 106 from the type specimen. x250.
Exsic: Sydow Ured. *1877*.
Type: Mexico; Zapotlan, Jalisco, on Cuphea Hookeriana. Oct. 9, 1903. Holway No. 5142.

The photograph shows the teleutospores much more regular than the average are found to be. Puccinia Cupheae has much darker teleutospores, nearly all with the apex round.

107. Puccinia Cupheae Holw.

Ann. Mycol. **2**:393. 1904.

III. Teleutosori dark brown, up to 1mm in diameter, on red and yellow spots, mostly hypophyllous, scattered or circinate in small often confluent groups; teleutospores smooth, brown, elliptical to oblong, constricted at the septum, upper cell nearly always rounded, apex 4—7μ thick, lower cell mostly nar-

rowed to the base, 37—48×15—19μ; pedicel persistent, hyaline or slightly tinted next the spore, 20—50μ long.

On Cuphea aquipetala Cav., C. procumbens Cav. Mexico.

Photo: No. 107. From the type x250.
Type: Mexico. Near the City of Mexico, on Cuphea aquipetala, Oct. 29, 1899, Holway No. 3750.

ONAGRACEAE.

JUSSIAEA.

108. Puccinia sphaeroidea P. Henn.

Hedw. **42**:(107). 1903.

III. Sori hypophyllous and caulicolous, chestnut-brown, round, pulvinate, punctiform to ⅓mm in diameter, scattered; teleutospores elliptical or ovoid, smooth, pale yellowish-brown, wall 3μ thick, uniform, apex rounded, not at all or slightly constricted at the septum, both cells rounded and of the same size, or the lower somewhat narrowed to the base, 20—30×15—25μ; pedicel persistent, yellowish, 3—4μ wide, often inserted more or less laterally.

On Jussiaea sp. Lower California.

Photo: No. 108. From the type, x500.
Type: Lower California. "Sierra del Taste li San Jose de Cabo. pr. Baja, in Stengeln und Blättern von Jussiaea sp. 1902. C. A. Purpus."

LUDWIGIA.

109. Puccinia Ludwigiae (E. & E.) Holway n. comb.

Syn: Aecidium Ludwigiae E. & E. Proc. Phil. Acad. :155. 1893.
Puccinia Nesaeae E. & E. Bull. Torr. Bot. Cl. 22:363. 1895.
Dicaeoma Nesaeae Kuntze, Rev. Gen. Pl. 3^2:469. 1898.
Allodus Nesaeae Arth. Resultats sc. du Cong. intern. de Bot. 1905:345. 1906.
(Not Aecidium Nesaeae Ger. Bull. Torr. Bot. Cl. **4**:47. 1873.)

O. I. Spots purple, round to irregular, usually small, rarely up to 3mm in diameter; spermogonia epiphyllous, opposite the aecidia, dark red to black; aecidia hypophyllous, minute, ¼mm in diameter, scattered or clustered, rarely compact and pulvinate, 1—2mm in diameter; perida breaking irregularly, not reflexed, cells 15—28μ in length, tuberculate; aecidiospores angular, yellow, minutely verrucose, 15×12μ.

III. Teleutosori firm, amphigenous, mostly hypophyllous, minute, black, at first following in the aecidia, later surrounding and opposite them on the other side of the leaf, in small compact clusters, rarely scattered singly, surrounded by the ruptured epidermis; teleutospores brown, smooth, oblong to clavate, constricted at the septum, lower cell narrowed to the pedicel, upper cell mostly larger, apex more or less thickened up to 8μ, acute, obtuse, or

rarely truncate, 36—64×16—24μ; pedicel usually short, sometimes up to 60μ long, persistent, hyaline or slightly tinted.

I. III. On Ludwigia polycarpa S. & P., Iowa. Mo.

Photo: No. 109. From the type specimen x250.

Type: I. Delaware. "On the leaves of Ludwigia sphaerocarpa. Sept. 1892. (Commons No. 1893).

III. Mo. "On leaves of Nesaea verticillata." (error in determination, is Ludwigia polycarpa), "near Concordia, (Rev. C. H. Demetrio No. 145)."

Specimens from the collector as well as the type have been examined and there is no question as to the host.

Aecidium Isnardiae Lagerh. Tromsoe Mus. Aarshefter 17:102. 1895, may be a synonym. Dr. Farlow says: "This species of Lagerheim is apparently founded on Lea's specimen in Herb. Fries and we have placed under the name Aecidium Isnardiae Lagerh. all the references to Aecidia as quoted on Isnardia. It is not improbable that Aecidium Isnardiae should be referred to Aecidium Ludwigiae Ell. & Ev. published two years earlier, but the specimens of the first named species which we have examined are not sufficient to settle that point."

EPILOBIUM.

110. Puccinia Epilobii DC.

Flora Fr. 6:61. 1815.

Syn: Dicaeoma Epilobii Kuntze, Rev. Gen. Pl. 3^2:468. 1898.
Dasyspora Epilobii Arth. Resultats sc. du Cong. intern. de Bot. 1905:346. 1906.

III. Teleutosori amphigenous, round, often closely covering the leaf, finally confluent, pulverulent, brown; teleutospores yellowish-brown, elliptical to oblong, variable in size, strongly constricted and easily separating at the septum, mostly rounded at the ends, lower cell rarely narrowed to the base, cells mostly of the same shape and size, wall uniformly 2μ thick, apical papilla very small, mostly not noticeable, germ-pore of the upper cell at the apex, that of the lower cell towards the pedicel, epispore minutely but distinctly verrucose, 32—44×20—26μ; pedicel short, hyaline, fragile.

On Epilobium alpinum L. var., Gaspe Co. Quebec, Canada. Epilobium sp. Wyoming. Nelson Pls. Yellowstone Park No. *6431*.

Photo: No. 110a. From the Wyoming specimen x500.
No. 110b. From the Canadian specimen, x500.

Type: France. On Epilobium organifolium. "J'ai trove cette puccinie en ete, sur l'epilobe a feuilles d'origan, auteur de Querigut, dans les Pyrenees:"

111. Puccinia scandica Johans.

Bot. Not. :175. 1886.

Bot. Centralbl. 28:395. 1886.

Syn: Dicaeoma scandicum Kuntze, Rev. Gen. Pl. 3^2:470. 1898.
Dasyspora scandica Arth. Resultats sc. du Cong. intern. de Bot. 1905:347. 1906.

III. Teleutosori mostly hypophyllous, small, round, often thickly covering the leaf, early naked and confluent, very pulverulent, reddish-brown; teleutospores yellowish-brown, oblong, constricted at the septum, apex rounded, with a low, broad, hyaline papilla, upper cell often larger, the lower mostly somewhat narrowed to the pedicel, wall uniformly 2μ thick, very minutely and evenly verrucose, 28—36×14—20μ; pedicel hyaline, fragile, about 20μ long.

On Epilobium alpinum L., E. clavatum Trel., Utah; E. clavatum Trel. Wash.

Exsic: Vestergren Micromyctes *980*; Sydow Ured. *1940. 2038*; Garrett Fg. Utah. *84.*

Photo: No. 111. From the Washington specimen, x500.

Type: Sweden. "Auf Epilobium anagallidifolium (E. alpinum) auf mehreren Stellen der Hoch Gebirge Jämtlands."

Mr. Garrett has collected an aecidium on Epilobium alpinum which he thinks is a stage of this Puccinia but the connection is not shown by the specimens so far examined. It is much like Puccinia Epilobii, from which it differs in its smaller teleutospores, larger apical papillae and more minute tubercles.

CHAMAENERION. (EPILOBIUM.)

112. Puccinia gigantea Karst.

Bidrag Finlands Natur. **32**:42. 1879.

Syn: Puccinia annulata E. & E. Bull. Torr. Bot. Cl. **27**:60. 1900.
Puccinia pileata Mayor. *Bull. Soc. neuchat. des sc. Natur. **29**:67. 1901.
Dicaeoma giganteum Kuntze, Rev. Gen. Pl. **3**^{2}:469. 1898.

III. Spots brown or reddish; teleutosori hypophyllous, very rarely a few epiphyllous, dark brown, almost black, firm, surrounded by the ruptured epidermis, consisting of small sori very closely compacted, sometimes confluent and appearing as one large sorus, ¾-3mm in diameter; teleutospores smooth, oblong to clavate, apex round or acute, sometimes with a long conical point, truncate, or irregular, strongly thickened, 4—12μ, constricted at the septum, pale brown, apex dark brown, upper cell usually shorter and broader and sometimes darker than the lower, which is mostly narrowed to the base, 30—60×10—16μ; pedicel hyaline, persistent, up to 60μ long.

On Chamaenerion angustifolium (L.) Scop. Banff, Canada.

Photo: No. 112. From the Banff specimens, x250.

Type: Finland. "In caulibus emortuis Epilobium angustifolii sero autumno."

The sori differ in the number of the teleutospores having the dark brown apices, but the photograph shows the usual form. The germ-pore of the upper cell is occasionally at one side of the apex.

EPILOBIUM.

113. Puccinia Epilobii-tetragoni (DC.) Wint.

Rabenh.-Wint. Krypt. Fl. **1**:214. 1884. Ed. 2.

Syn: Uredo vagans a. Epilobii tetragoni DC. Flora Fr. **2**:228. 1805.
Aecidium Epilobii DC. l. c. :238.
Uredo Epilobii DC. Fl. Fr. **6**:73. 1815.
Puccinia pulverulenta Grev. Flora Edinb. :432. 1824.

Trichobasis Epilobii Berk. *Outl. :333. 1860.
Puccinia intermedia Diet. & Holw. Bot. Gaz. 18:254. 1893.
Dicaeoma intermedium Kuntze, Rev. Gen. Pl. 3^2:469. 1898.

O. I. Spermogonia few, scattered among the aecidia, yellow; aecidia covering the under side of the leaf, rarely a few scattered on the upper surface, orange-yellow, peridia reflexed, splitting into few parts; peridial cells often 7—8μ thick on the outside, 3—5μ thick on the inside, closely covered with small roundish tubercles; aecidiospores globose to angular, wall thin, very minutely verrucose, 15—20μ in diameter.

II. Uredosori amphigenous, cinnamon-brown, small, round, scattered, at first covered by the epidermis, occuring only early in the season; uredospores most often intermixed with the teleutospores, brown, globose to elliptical, wall 2.5—3μ thick, with short tubercles 2—3μ apart, 20—28×17—20μ, with two opposite germ-pores.

III. Teleutosori amphigenous, small, round, scattered or finally confluent and covering large parts of the stems, chestnut-brown, pulverulent; teleutospores brown, elliptical to oblong, slightly constricted at the septum, both cells rounded or the lower somewhat narrowed, or the apex sometimes more or less pointed, from slightly thickened up to 10μ thick, from minutely to strongly verrucose, the tubercles short and irregular, but covering the surface closely and evenly, the germ-pore of the upper cell at the apex, that of the lower cell near the middle, or often with two opposite germ-pores, the elliptical spores 25—30×17—23μ, the oblong ones 25—45×16—23μ; pedicel hyaline, fragile, slender, up to 65μ long.

On Epilobium paniculatum Nutt. Calif., Ore., S. Dak., Mont., Utah, Col. Epilobium rigidum Haussk., Ore.; Epilobium sp. Wyo., Nev., Idaho.

Exsic: Griff. West Am. Fg. *383. 383a.* Ellis N. A. F. *1846. 3477.* Sydow Ured. *881.* Rabh.-Wint. Fg. eur. *3618.* Garr. Fg. Utah. *86. 110.*

Photo: 113a. From Epilobium hirsutum, Germany. Sydow Ured. No. 18. x500
113b. From Epilobium paniculatum, Utah, Garrett No. 926, x500.
113c. From Epilobium sp. Calif. x500.
113d. From type of Puccinia intermedia D. & H. Calif. x500.

Type: France. "La variete a, qui m'a ete communique par M. Chaillett croit sur l'epilobe tetragoni, ou elle est quelque fois melangee sur la feuille avec l'aecidium de l'epilobe."

The specimens vary considerably in the strength of the tubercles, which in the form described as Puccinia intermedia are very prominent. With a large collection, however, a perfect series can be formed, beginning with the one photographed in figure 113b, which is slightly verrucose and ending with the Puccinia intermedia forms, and it is impossible to make any division. Some specimens have the broad teleutospores intermixed with the oblong form, and all degrees of thickness of the apex and wall can be found. The uredospores are the same in all, as is the number and position of the germ-pores of the teleutospores, although some specimens have very few spores with the two germ-pores in the lower cell.

The European specimens are described as having smooth teleutospores, but they all show the same markings as the American specimens, those from Epilobium lanceolatum, from France, Vestergren Micromycetes *961.* being strongly verrucose. Puccinia Epilobii-Fleischeri Fischer has recently been described from Switzerland, having only aecidia and teleutospores, the latter mostly oblong, much like some American specimens, but all ours that have been examined have uredospores.

Specimens with aecidia, however, show a tendency to produce only aecidia and teleutosori, especially when collected at a high altitude.

Puccinia Gayophyti can be readily distinguished from Puccinia Epilobii-tetragoni by the position of the germ-pore, and the host plants, which are often mixed in collections, can be certainly separated by the hairs on the young growths.

One-celled teleutospores are occasionally found, having two germ-pores near the base.

Teleutospores with two germ-pores in the lower cell are shown in figure 113c. They were very commonly so in this collection.

BOISDUVALIA.

114. Puccinia glabella Holway n. sp.

II. Uredosori not seen; uredospores intermixed with the teleutospores, brown, globose, elliptical, or somewhat angular, echinulate, wall 3—4μ thick, 22—30$\times$ 20—25μ; germ-pores 2, equatorial, with large, flat, hyaline papillae.

III. Teleutosori amphigenous, dark brown, round, punctiform to 1mm in diameter, often pulvinate, long covered by the epidermis, finally pulverulent; teleutospores brown, oblong, smooth, both cells rounded or the lower a little narrowed, apex mostly rounded, sometimes obtusely pointed, constricted at the septum, wall 2μ thick, becoming thinner in the lower cell, apex not at all or only slightly thickened, germ-pore of the upper cell at the apex or more or less to one side, that of the lower cell from near the septum to the middle, 25—32$\times$15—18μ; pedicel hyaline, fragile, short.

On Boisduvalia glabella (Nutt.) Walp. Oregon.

Exsic: Griffith West Am. Fg. *385*.
Photo: No. 114. x500.

This species was distributed as Puccinia Boisduvaliae Peck, but is a very different thing.

BOISDUVALIA. OENOTHERA EULOBUS. CLARKIA. GODETIA.

115. Puccinia Oenotherae Vize.

Grev. **5**:109. 1877.

Syn: Puccinia Boisduvaliae Peck. Bot. Gaz. **7**:45. 1882.
Puccinia Clarkiae Peck. Bull. Torr. Bot. Cl. **11**:49. 1884.
Puccinia Eulobi Diet. & Holw. Erythea **1**:249. 1893.
Aecidium Clarkiae Diet. & Holw. Erythea **2**:129. 1894.
Puccinia Sphaerostigmatis Diet. & Neg. Eng. Bot. Jahrb. **22**:353. 1896.
Dicaeoma Boisduvaliae Kuntze, Rev. Gen. Pl. **3**^{2}:468. 1898.
Dicaeoma Clarkiae Kuntze. l. c. :

I. Aecidia hypophyllous, usually covering the entire leaf, orange yellow, margin reflexed, split into numerous divisions; aecidiospores pale yellow, globose or angular, closely and evenly punctate, 15—23μ in diameter.

II. Uredosori amphigenous, round, brown, early naked and pulverulent, ½-1mm in diameter; uredospores brown, globose to ovate, echinulate, 20—32μ in diameter, ovate ones 20—37$\times$18—25μ; germ-pores 2—4. mostly 2.

III. Teleutosori amphigenous, dark brown, long covered by the epidermis which remains prominent, pulvinate, firm, punctiform to 2mm in diameter; teleutospores brown, smooth, elliptical to oblong, often constricted at the septum, apex round, or obtusely pointed, rarely acute, not at all thickened or up to 12μ, lower cell mostly rounded, rarely narrowed to the base, 28—52×16—32μ, not often less than 20μ wide, occasional spores up to 64μ long; pedicel persistent, hyaline or slightly tinted, up to 100μ long.

On Oenothera strigulosa Torr. & Gray, O. micrantha Hornem., O. hirtella Greene, O. spiralis Lehm., Eulobus Californicus Nutt. Clarkia elegans Lindl., Godetia Bottae Spach., G. amoena Don., Zauschneria Californica Presl., California; Godetia epilobioides (Nutt.) Wats., Clarkia rhomboidea Dougl., Wash.; Boisduvalia densiflora (Lindl.) Wats., Calif. Wash.; B. Torreyi Wats. Calif.

Exsic: Sydow Ured *864. 865. 866. 1063. 1064. 1768*: Baker Pls. Pac. Coast. *4869. 4872*; Ellis, N. A. F. *3140. 3139.*

Photo: No. 115a. On Zauschneria Californica, Calif. x250.
No. 115b. On Clarkia elegans, Calif. x250.
No. 115c. On Oenothera hirtella, Calif. x250.
No. 115d. On Oenothera micrantha, Calif. Elmer No. 3192, x250.
No. 115e. On Oenothera strigosa, Calif. x250.
No. 115f. On Oenothera bistorta, Calif. x250.
No. 115g. On Boisduvalia Torreyi, Calif. x250. Type specimen of Puccinia Boisduvaliae Peck.
No. 115h. On Eulobus Californicus, Calif. x250. Type specimen of Puccinia Eulobi Diet. & Holw.

Type: Calif. "On Oenothera densiflora. No. 251."

A variable species so far as the size of the teleutospores is concerned. In the same sorus broad teleutospores are found along with the narrow, oblong ones. On Oenothera bistorta they measure 36—52×22—28, on Oenothera hirtella they are mostly 28—40×20—24μ, while on Oenothera micrantha they are even smaller.

All of the species of Oenothera on which the fungus has been seen are those now placed by some botanists in the genus Sphaerostigma. The type of Puccinia Oenothera was on Oenothera densiflora, now known as Boisduvalia densiflora; the teleutospores on a specimen of this host collected by Jepson at San Francisco are exactly the same as those on Oenothera bistorta, while specimens collected by Piper in Wash. and by Blasdale in Calif., have numerous elliptical teleutospores 36—40×24—38μ. In the type specimen of Puccinia Boisduvaliae Peck they measure 40—48×20—24μ. Different collections on Clarkia vary in the same way, while those on Godetia are all the oblong large teleutospores. Only a single collection has been seen on Eulobus.

Aecidia have been examined on Oenothera, Clarkia, Eulobus, Zauschneria and Boisduvalia, and they seem to be identical. No difference can be found in the uredospores.

Ample collections of all the stages on all the different hosts will be necessary before any positive arrangement of the species can be made.

TARAXIA.

116. Puccinia heterantha E. & E.

Erythea **1**:204. 1893.

Syn: Dicaeoma heteranthum Kuntze. Rev. Gen. Pl. **3**^{2}:469. 1898.

O. I. Spermogonia numerous, reddish-yellow, scattered among the aecidia; aecidia amphigenous, quite evenly covering the leaves, margin white, reflexed, split

into few segments; aecidospores orange, globose or more or less angular, minutely verrucose, wall thin, 17—20μ in diameter.

II. III. Spots none or reddish; sori mostly epiphyllous, chestnut-brown, round, punctiform to 1mm. in diameter, surrounded by the ruptured epidermis, pulverulent; uredosori rarely seen; uredospores intermixed with the teleutospores, brown, globose to obovate, wall 2μ thick, echinulate, spines short, 17—26μ in diameter; germ-pores 2. rarely 3.

Teleutospores brown, smooth, elliptical-oblong, mostly rounded at the apex, not at all thickened or up to 7μ thick, slightly constricted at the septum, the lower cell mostly rounded and often somewhat smaller, occasional spores angular or irregular with the apex at one side of the cell, 25—38× 18—28μ; germ-pore of the lower cell at the septum; pedicel subpersistent, hyaline, rather stout, up to half the length of the spore.

On Taraxia ovata (Nutt.) Small, Calif.; T. heterantha (Nutt.) Small. Utah. Mont.

Exsic: Ellis N. A. F. *2986. 2995*; Garrett Fg. Utah. *92*; Sydow Ured. *874. 875.*
Photo: No. 116. From Taraxia ovata, Calif. x250.
Type: Mont. "On Oenothera heterantha, Basin, July 1892. F. D. Kelsey."

GAYOPHYTUM.

117. Puccinia Gayophyti Billings.

U. S. Geol. Explor. 40th. Par. **5**:414. 1871.

Syn: Aecidium Gayophyti Vize. Grev. **7**:12. 1878.
Puccinia Gayophyti Peck. Bot. Gaz. **7**:56. 1882.
Dicaeoma Gayophyti Kuntze, Rev. Gen. Pl. **3**^{2}:468. 1898.
Puccinia Gayophyti Speg. An. Mus. Nac. Buenos Aires. **8**:63. 1902.

I. Spots none; aecidia hypophyllous, often covering the entire leaf, 225—325μ in diameter, margin reflexed, divisions few; aecidiospores orange-yellow when fresh, globose or slightly angular, very minutely punctate, 20—24μ in diameter.

II. Uredosori round, amphigenous, light brown, at first covered by the epidermis, soon pulverulent; uredospores brown, mostly globose or subglobose, rarely elliptical, wall 3μ thick, echinulate, spines about 2—2.5μ apart, with two opposite germ-pores, 20—25×17—25μ.

III. Teleutosori amphigenous scattered, dark brown, early naked and very pulverulent, becoming confluent and covering the entire leaf; teleutospores brown, smooth, elliptical, occasionally oblong or irregular, both cells rounded or the lower narrowed to the pedicel, rarely with the upper cell tapering to the apex, wall mostly 3μ thick, becoming somewhat thinner in the lower cell, apex either not thickened or up to 6μ thick, germ-pore of the upper cell at the apex, that of the lower cell always near the septum, each with a hyaline papilla, 28—40×18—25μ; pedicel slender, hyaline, very fragile, short.

On Gayophytum sp. Col. Nev. Calif. Wyo.; G. ramosissimum T. & G., Ariz. Mont. Wyo. Idaho, Utah; G. diffusum T. & G. Idaho, Utah; G. racemosum T. & G. Wyo.; G. caesium Nutt., G. intermedia Rydb., G. lasiosperma Greene, Utah.

Exsic: Garrett Fg. Utah. *40. 50*: Griff. West Am. Fg. *381*; Nelson Pls. Wyo. *7981*; Baker, E. & T. Pls. So. Col. *1046*; Baker Pls. So. Col. *58*; Sydow Ured. *1918. 1919*; Vestergren Micromycetes *964*; Ellis & Ev. Fg. Columb. *1851*.
Photo: No. 117. From G. ramosissimum, Flagstaff, Ariz. McDougal No. *1960*. x500.
Type: Nev. "On Gayophytum sp. (1543)."

CIRCAEA.

118. Puccinia Circaeae Pers.

Roemer, Neues Mag. **1**:119. 1794.

Syn: Puccinia Circaeae Fckl. p. p. Jahrb. Nass. Ver. f. Naturk. **23**:53. 1869.
Puccinia Circaeae Mart. p. p Prod. Fl. Mosq. :228. 1817. Ed. 2.
Dicaeoma Circaeae Kuntze, Rev. Gen. Pl. **3**²:468. 1898.
Dasyspora Circaeae Arth. Resultats sc. Cong. intern. d. Bot. 1905. :346. 1906.

III. Spots yellow, brown, or brilliant crimson, round to irregular; teleutosori hypophyllous, generally small, firm, scattered or circinate in groups 2—5mm in diameter; on C. Lutetiana the sori are yellow and germinating, or later, on the stems and petioles, confluent in large pulverulent dark brown sori; on the other hosts the sori are dark brown, often with the central ones germinating, or all ungerminated; teleutospores clavate to fusiform, apex lighter colored, round to acute and up to 8μ thick, constricted at the septum, cells of the same shape and size, rarely the upper somewhat broader and the lower narrowed to the base, 24—36×10—16μ, hyaline or light yellow in the germinating sorus, brown in the other; pedicel hyaline, persistent, up to 60μ long.

On Circaea Lutetiana L. Common; probably occurs wherever the host is found; C. alpina L., N. H., Minn., N. Y., Mich.; C. Pacifica Aschers. & Magnus, Calif., Ore.

Exsic: Sydow Ured. *1118*; Ellis, N. A. F. *250. 1030*; Kellerm. Ohio Fg. *29*; Thuem. Mycoth. univer. *1330*; Arth. & Holw. Ured. Exsic. *2*.
Photo: No. 118a. From C. alpina, Mich. x250.
No. 118b. From the pulverulent sori of C. Lutetiana, Decorah, Ia. x250.
Type: Locality not given. "(In fol. Circ. lutet.)"

The form with the large pulverulent sori has been seen but once. The teleutospores in these sori are said to germinate only in the spring.

FUCHSIA.

119. Puccinia Fuchsiae Syd. & Holw.

Ann. Mycol. **4**:30. 1906.

III. Spots purple, teleutosori firm, light brown, hypophyllous, small, round, mostly scattered in small groups 1—4mm. in diameter, more or less circinate, rarely in large irregular clusters along the midrib of the leaf; teleutospores germinating at once, pale yellow, almost hyaline, smooth, oblong-clavate, constricted at the septum, apex rounded, rarely sub-acute, up to 8μ thick, lower cell

narrowed to the base, 30—50×12—18μ; pedicel broad, persistent, hyaline, up to 40μ long.

On Fuchsia thymifolia H. B. K., Amecameca, Mexico.

Exsic: Sydow Ured, *1976*.
Photo: No. 120. Type specimen, x250.
This is much like Puccinia Jussiaeae Speg. but differs in habit and size of spores.

HALORRHAGIDACEAE.

PROSERPINACA.

120. Puccinia Proserpinacae Farlow.

Proc. Amer. Acad. Arts & Sc. **18**:80. 1882.

Syn: Puccinia Epilobii DC. var. proserpinacae Farlow. Ellis N. A. F. *260*.

II. Uredosori not seen; uredospores sparingly intermixed with the teleutospores, ovate to globose, pale brown, echinulate, germ-pores 2, near the apex, 24—30×20—25μ.

III. Teleutosori amphigenous, firm, brown, round, small, scattered or in small groups; teleutospores germinating at once, pale yellowish-brown, smooth, oblong to clavate, constricted at the septum, apex rounded to subacute, up to 8μ thick, lower cell narrowed to the base, sometimes rounded, 36—48×13—20μ; pedicel persistent, hyaline, 20—50μ long.

On Proserpinaca pectinata Lam., Mass. P. palustris L. Wisc.

Exsic: Ellis N. A. F. *260*; Ellis & Ev. Fg. Columb. *1579*.
Photo: No. 120. From Wisc. specimen x250.
Type: Mass. On P. pectinata. Ellis. N. A. F. *260*.

Heteropteryx.

No. 80a. Puccinia sanguinolenta P. Henn. On Heteropteryx Portillana, Mex. x250.
No. 80b. The same x500.

PLATE 24

ROSACEAE (Continued.)

Prunus.

No. 83a. Puccinia Pruni-spinosae Pers. On Prunus persica, Miss. x500.
No. 83b. The same. On Prunus Besseyi, Kansas. x250.

GERANIACEAE.

Geranium.

No. 84. Puccinia Leveillei Mont. On Geranium Fremontii, Utah. x500.

OXALIDACEAE.

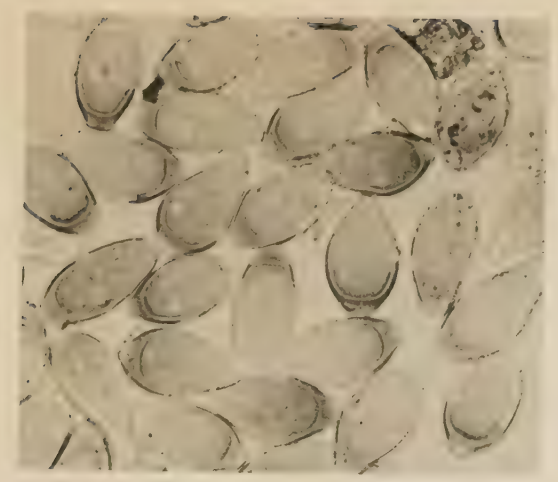
Oxalis.

No. 85 Puccinia Oxalidis Diet. & Ellis. On Oxalis sp. Mexico. x500.

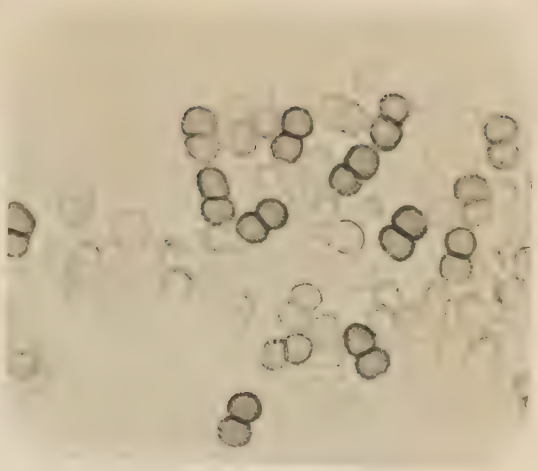
MALPIGHIACEAE.

Heteropteryx.

No. 86a. Puccinia sanguinolenta P. Henn. On Heteropteryx Portillana, Mex. x250.
No. 86b. The same x500.

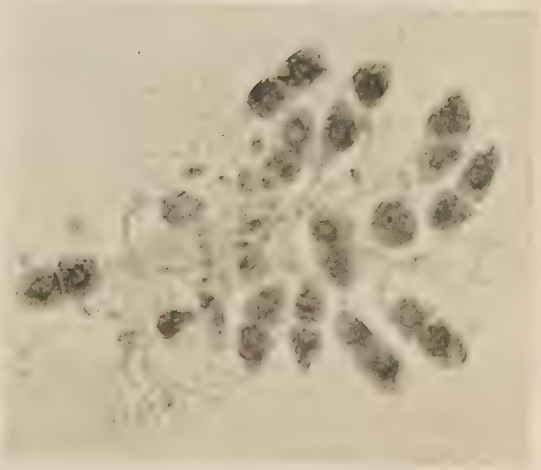


83a



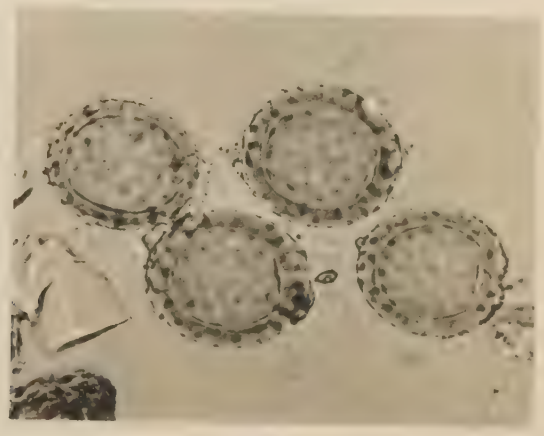
83b

84



85

86a



86b

PLATE 25

MALPIGHIACEAE (Continued.)

Stigmatophyllon.

No. 87a. Puccinia inflata Arth. On Stigmatophyllon periplocifolium, Cuba. x250.
No. 87b. The same x500.

Echinopteryx.

No. 88a. Puccinia Echinopteridis Holw. On Echinopteryx Lappula, Mex. x250.
No. 88b. The same x500.
No. 88c. The same x500.

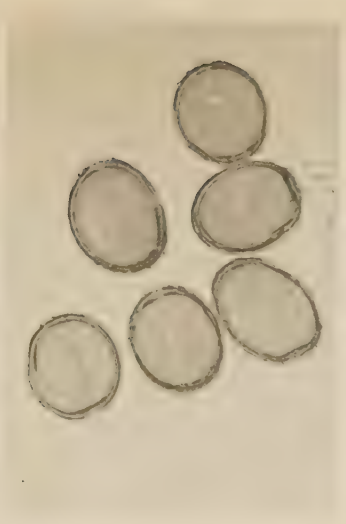
POLYGALACEAE.

No. 89. Puccinia Pyrolae Cooke. On Polygala paucifolia, Minn. x250.

EUPHORBIACEAE.

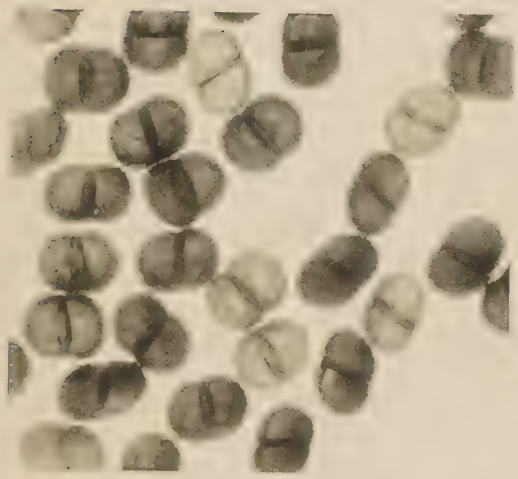
No. 90. Puccinia intumescens Holw. On Euphorbia calyculata, Mex. x250.

87a

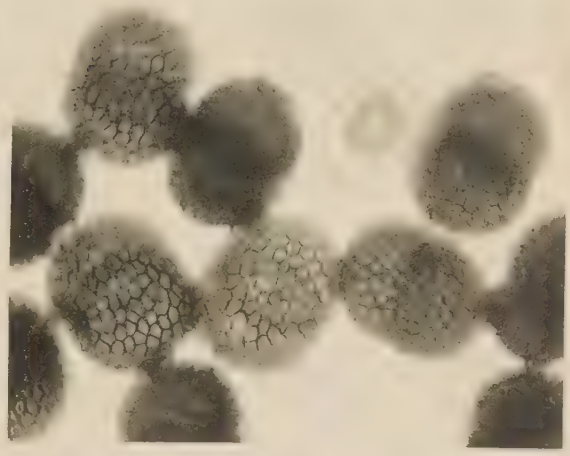


87b

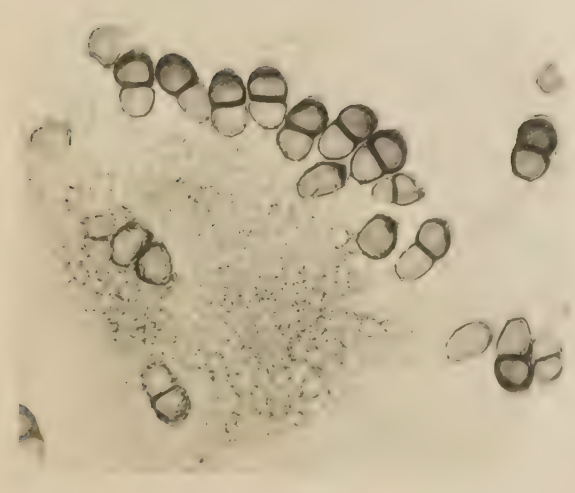
88c



88a



88b



89

90

Euphorbia. (Continued.)

No. 91b. The same x500.

Triumfetta.

No. 95. Puccinia Triumfettae Diet. & Holw. On T. semitriloba. Mex. x500.

PLATE 26

Euphorbia. (Continued.)

No. 91a. Puccinia Euphorbiae P. Henn. On Euphorbia scotana, Mex. x250.
No. 91b. The same x500.

SAPINDACEAE.

Serjanea. Cardiospermum.

No. 92. Puccinia Arechavaletae Speg. On Cardiospermum Halicacabum, Mex. x250.

BALSAMINACEAE.

Impatiens.

No. 93. Puccinia argentata (Schultz) Wint. On Impatiens aurea, Iowa, x500.

RHAMNACEAE.

Rhamnus.

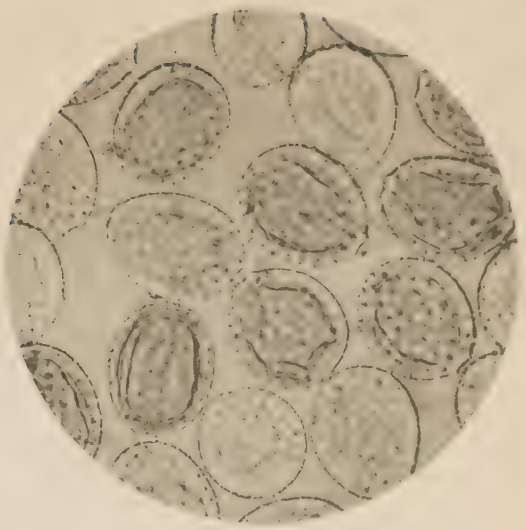
No. 94. Puccinia Mesnieriana Thuem. On Rhamnus crocea, Calif., x250.

TILIACEAE.

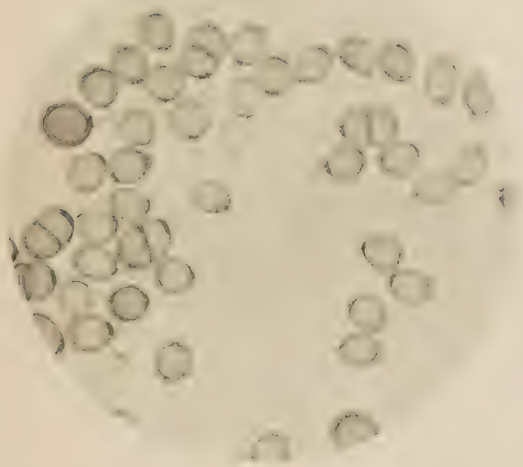
Triumfetta.

No. 95. Puccinia Triumfettae Diet. & Holw. On T. semitriloba, Mex. x500.

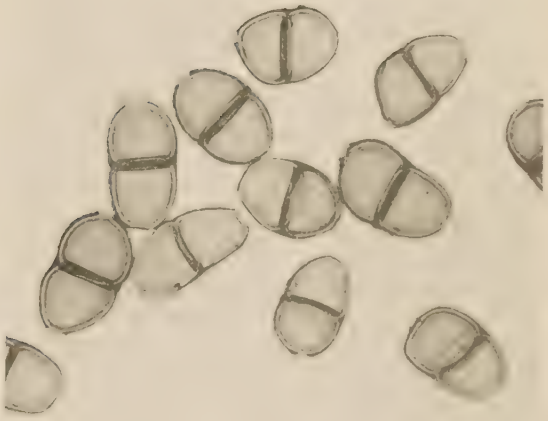
91a



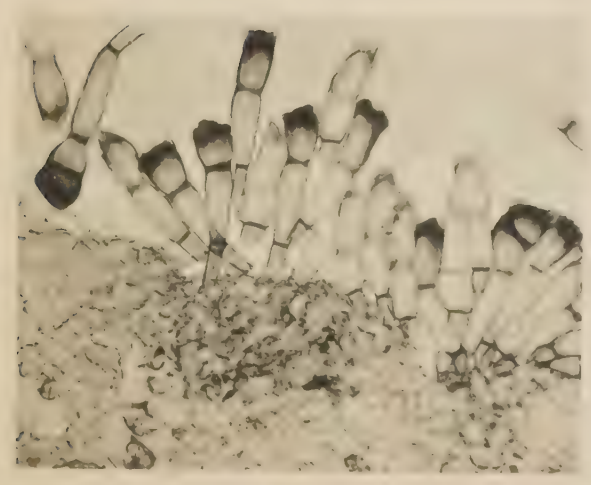
91b



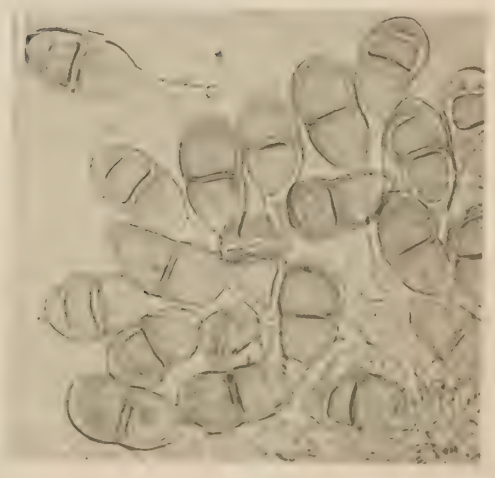
92



93



94



95

PLATE 27

MALVACEAE.

Malvastrum, Alph.

PLATE 27

MALVACEAE.

Sida. Malvastrum. Althaea.

No. 96a. Puccinia lobata B. & C. On Althaea rosea, Mex. x250.
No. 96b. The same. On Sida lepidota, Texas, Type specimen. x250.

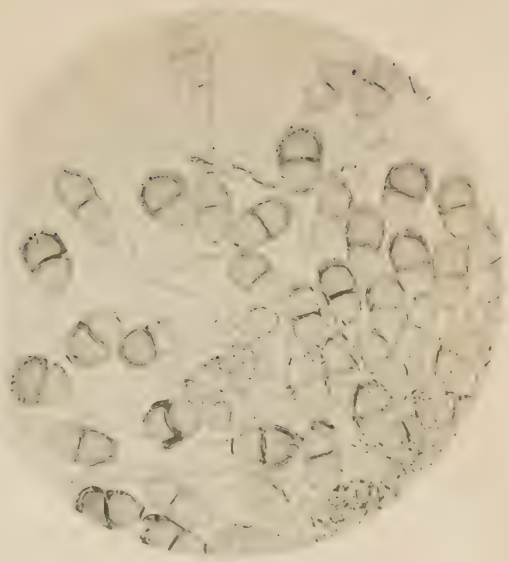
Sida. Abutilon. Anoda.

No. 97. Puccinia heterospora B. & C. On Abutilon Holwayi, Mex. x250.

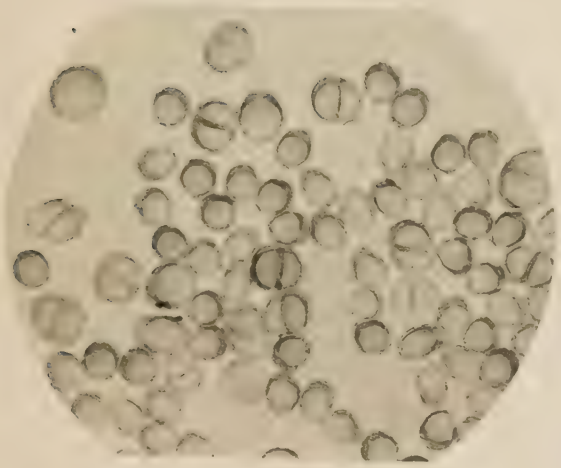
Malvastrum. Sidalcea. Sphaeralcea. Althaea.

No. 98a. Puccinia Sherardiana Koern. On Malvastrum Thurberi, Calif. x250.
No. 98b. The same, on Malvastrum coccineum, Canada, x250.
No. 98c. The same, on Althaea rosea, Calif., x250.

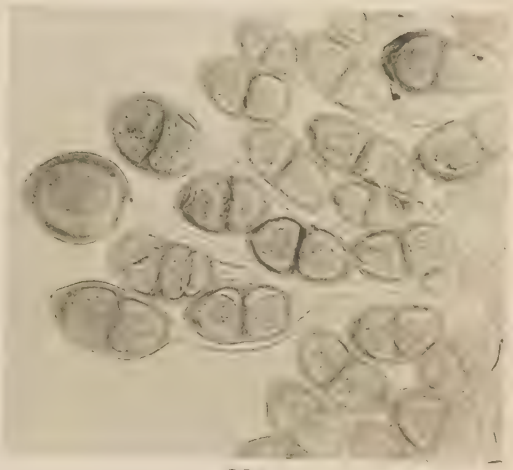
96a



96b

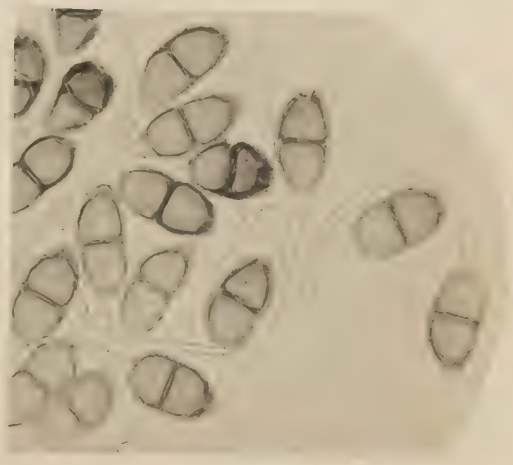


97



98a

98b



98c

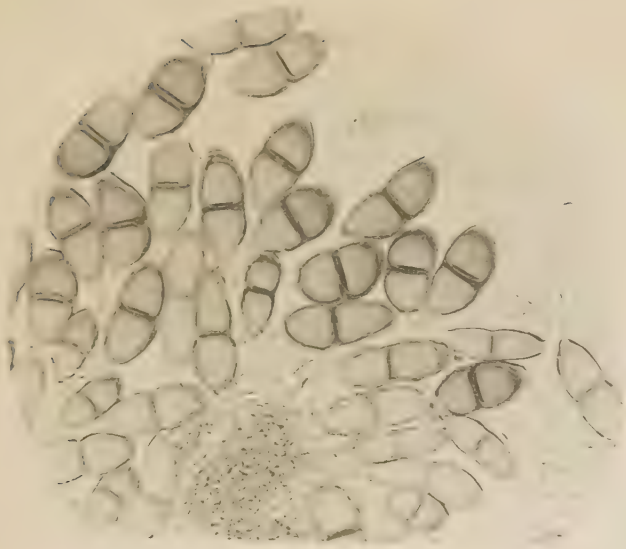
PLATE 28

Malvastrum. Sidalcea. Sphaeralcea. Althaea. (Continued.)

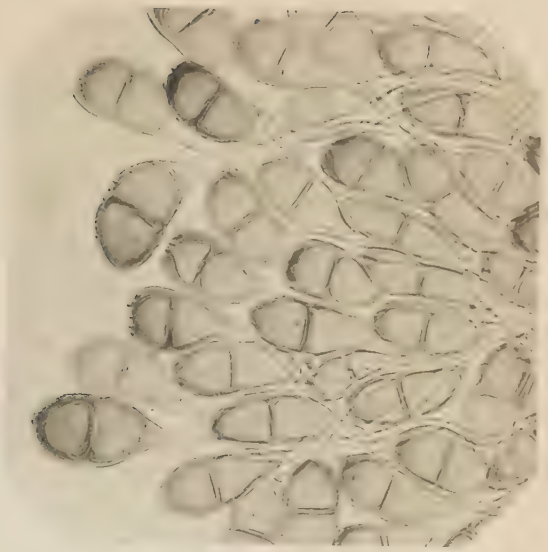
No. 98d. Puccinia Sherardiana Koern. On Sidalcea malvaeflora, Calif. x250.
No. 98e. The same, on Malvastrum sp. Calif. x250.
No. 98f. The same, on Malvastrum coccineum, Kansas, x250.
No. 98g. The same, on Sphaeralcea angustifolia. New Mex. Type specimen of Puccinia Sphaeralceae E. & E., x 250.

Althaea. Malva. Lavatera. Malvastrum.

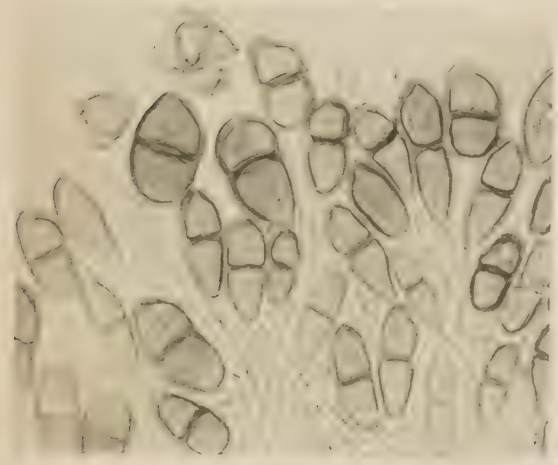
No. 99a. Puccinia Malvacearum Bertero, on Althaea rosea, Ohio. x250.
No. 99b. The same, from Washington, x250.



98d

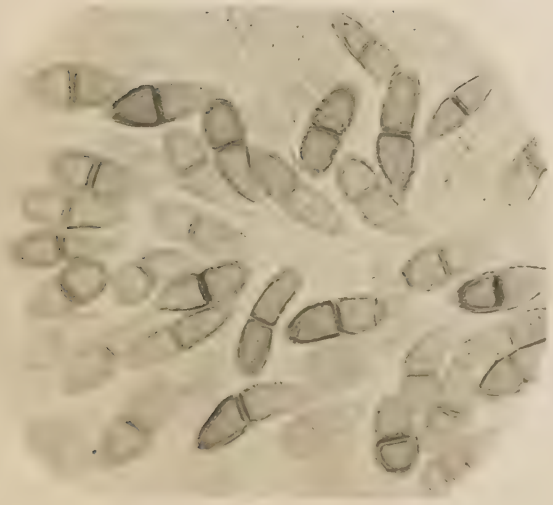


98e

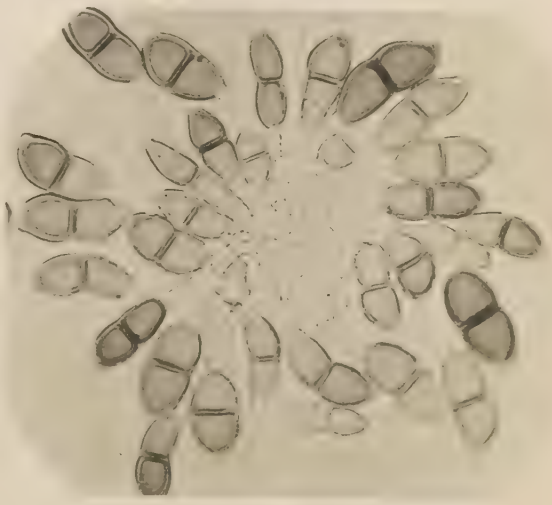


98f

98g



99a



99b

PLATE 29

Althaea. Malva. Lavatera. Malvastrum. (Continued.)

No. 99c. Puccinia Malvacearum Bertero. On Malvastrum sp. Mexico, x250.

Sidalcea.

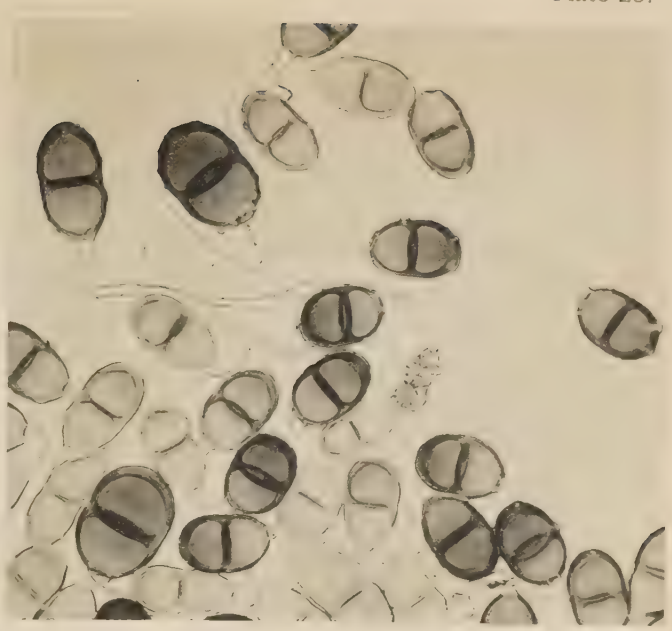
No. 100. Puccinia Sidalceae Holw. On Sidalcea Oregana, Ore., x250.

VIOLACEAE.

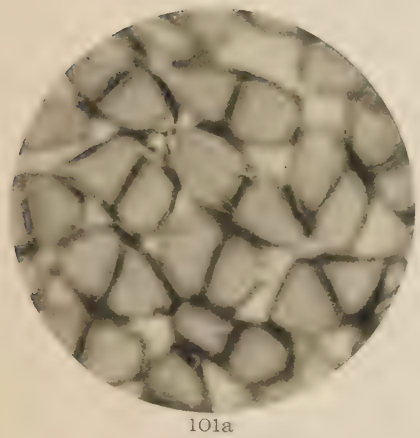
Viola.

No. 101a. Puccinia ornatula Holw. On Viola sp. Canada. x500.
No. 101b. The same, x500.
No. 102. Puccinia Fergussoni B. & Br. On Viola blanda, Utah. x500.
No. 103. Puccinia Canadensis Arth. On Viola orbiculata, Canada, x500.

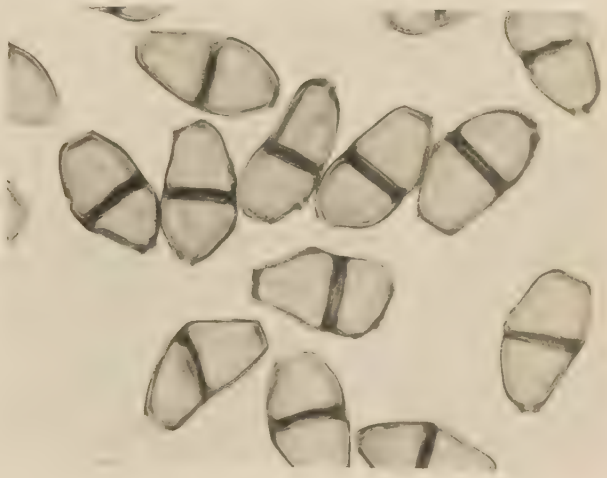
99c



100

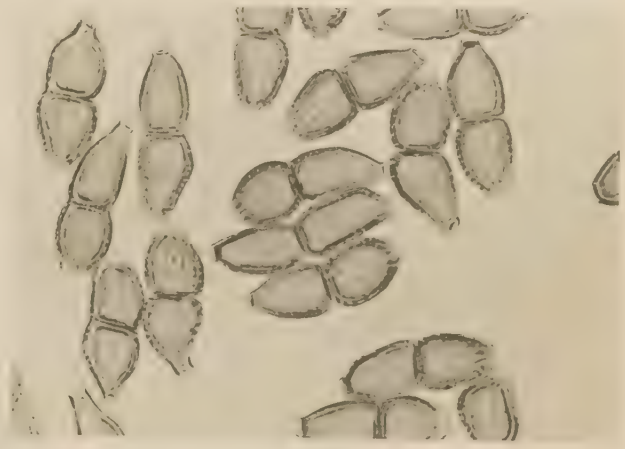


101a

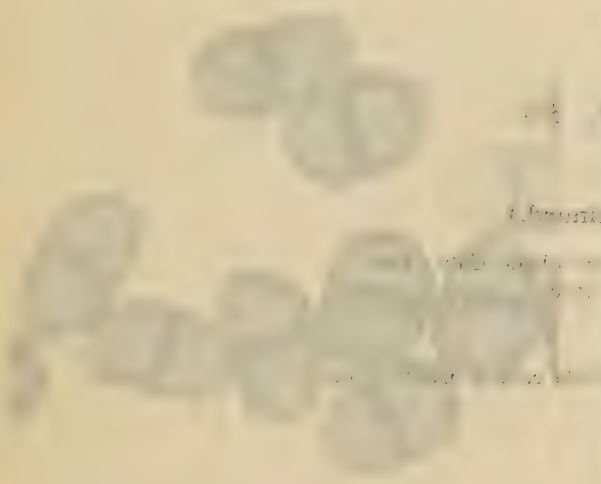


101b

102



103



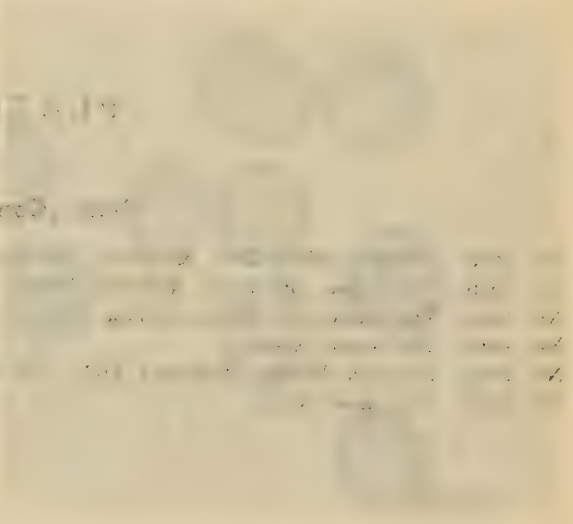
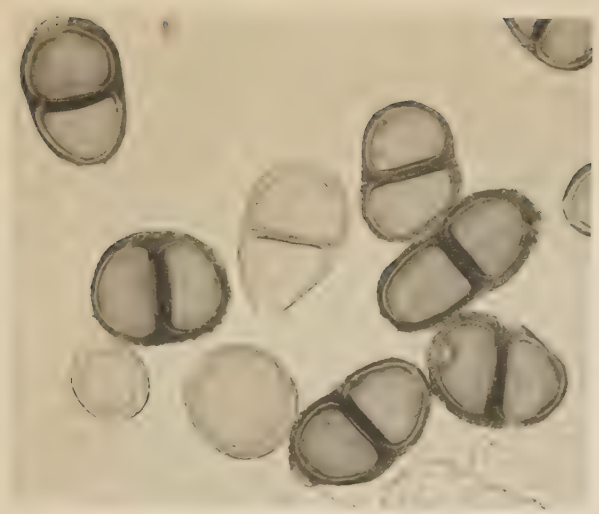


PLATE 30

Viola (Continued.)

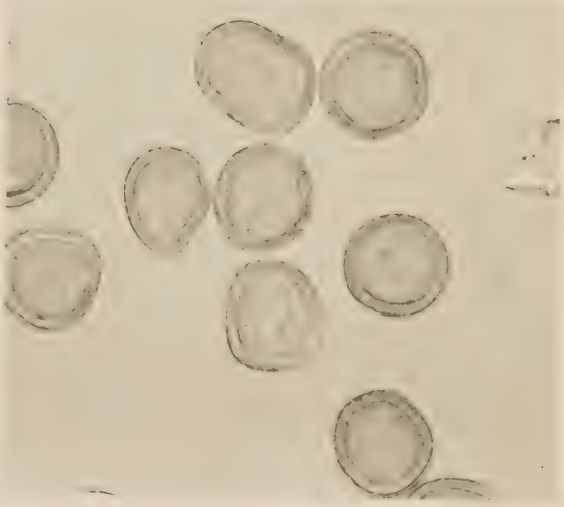
No. 104a. Puccinia effusa Diet. & Holw. On Viola lobata, Calif., x500.
No. 104b. The same, on Viola Nuttallii, Wash., x500.
No. 104c. The same, on Viola ocellata, x500.
No. 104d. The same, x500.
No. 105a. Puccinia Violae (Schum.) DC. On Viola canina, Calif., x500.
No. 105b. The same, x500.



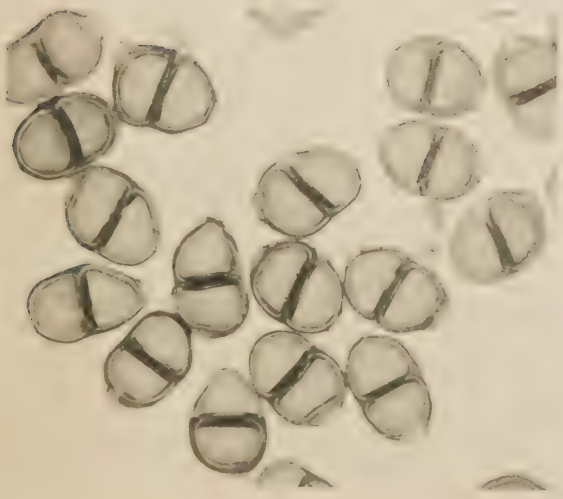
104a

104b

104c



104d



105a

105b

TABLE II

(Continued.)

Vermont, 256

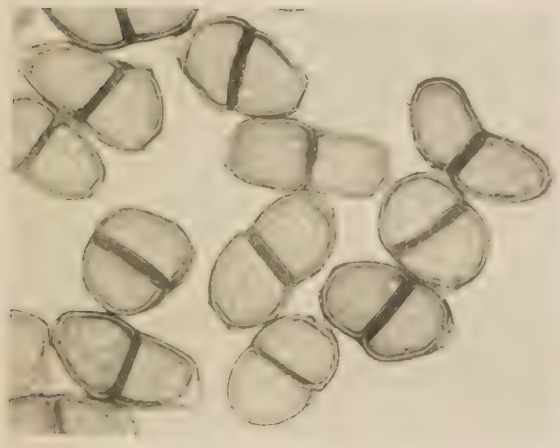
PLATE 31

Viola (Continued.)

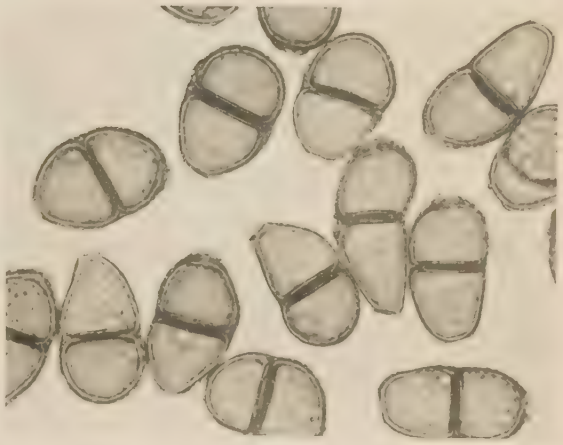
No. 105c. Puccinia Violae (Schum.) DC. On Viola primulaefolia, Maine, x500.
No. 105d. The same, on Viola glabella, Wash., type of Puccinia densa Diet. & Holw., x500.
No. 105e. The same, on Viola Rydbergii, Utah, x500.
No. 105f. The same, on Viola sp. Wyo. x500.
No. 105g. The same, on Viola sp. Glacier, B. C., x500.
No. 105h. The same, from Seym. & E. Econ. Fg. *456c*, Vermont, x500.

105c

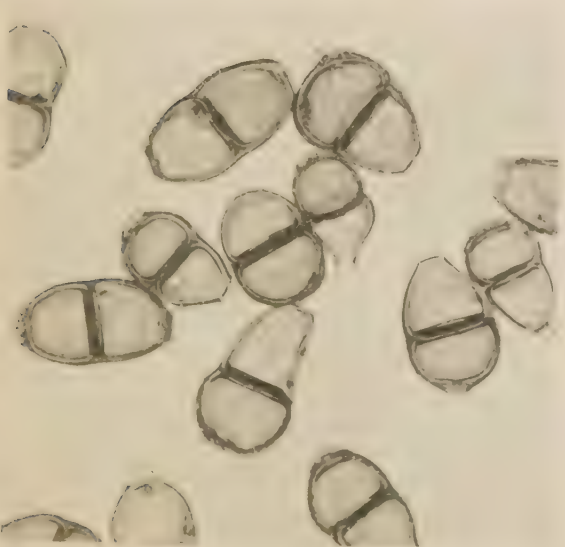
105d



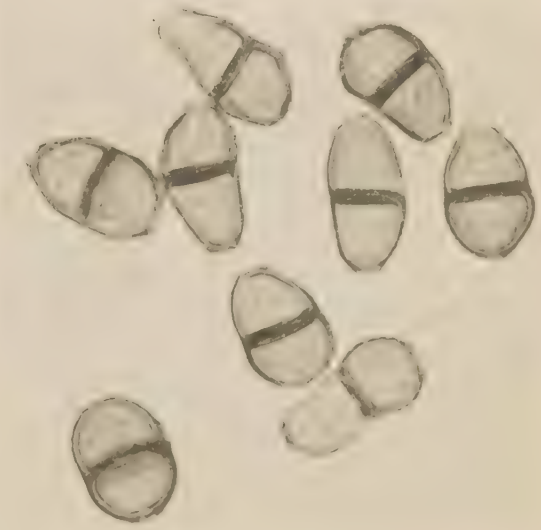
105e



105f



105g



105h

No. 109. Puccinia Ludwigiae Holw. On Ludwigia polycarpa. Mo. x250

PLATE 32

Viola (Continued.)

No. 105i. Puccinia Violae (Schum.) DC. On Viola cognata, Sisson, Calif., x500.
No. 105j. The same, on Viola Canadensis, Cloudcroft, New Mex. x500.

LYTHRACEAE.

Cuphea.

No. 106. Puccinia Jaliscensis Holw. On Cuphea Hookeriana, Mex., x250.
No. 107. Puccinia Cupheae Holw. On Cuphea aquipetala, Mex., x250.

ONAGRACEAE.

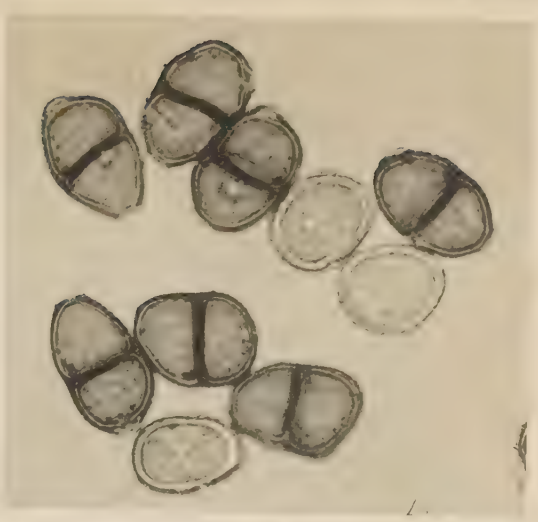
Jussiaea.

No. 108. Puccinia sphaeroidea P. Henn. On Jussiaea sp. x500.

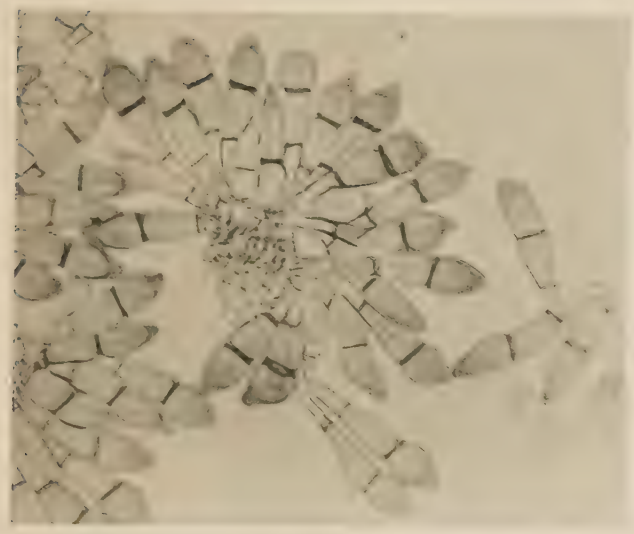
Ludwigia.

No. 109. Puccinia Ludwigiae Holw. On Ludwigia polycarpa, Mo. x250.

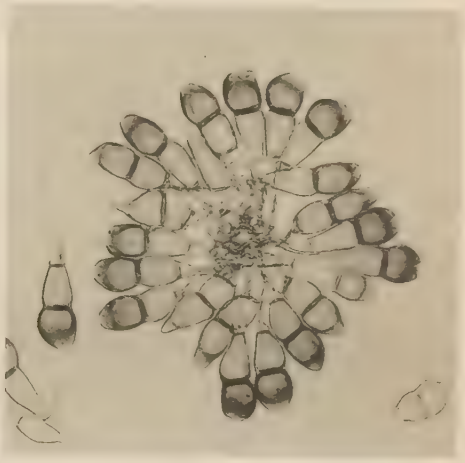
105i



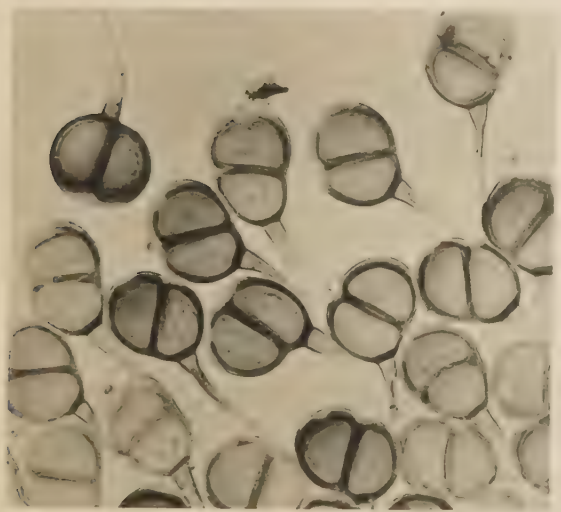
105j



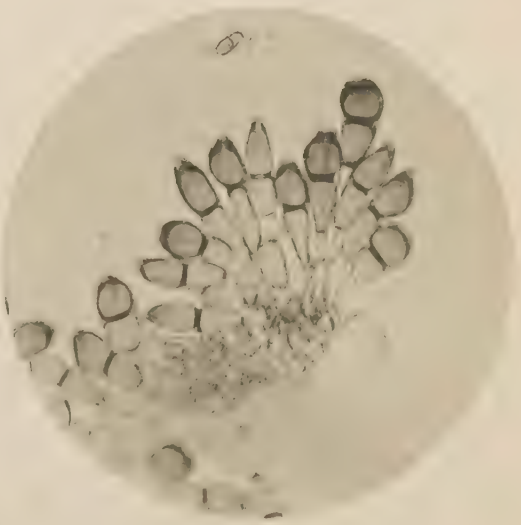
106



107



108



109

PLATE 33

PLATE 33

ONAGRACEAE (Continued.)

Epilobium.

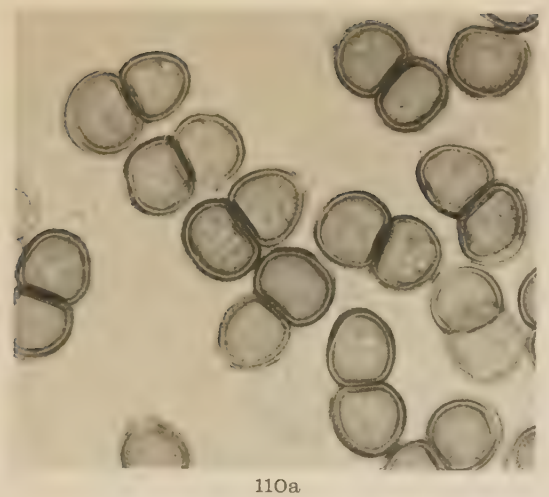
No. 110a. Puccinia Epilobii DC. On Epilobium sp. Wyoming. x500.
No. 110b. The same, Epilobium alpinum, Canada, x500.
No. 111. Puccinia scandica Johans. On Epilobium clavatum, Wash. x500.

Chamaenerion. (Epilobium.)

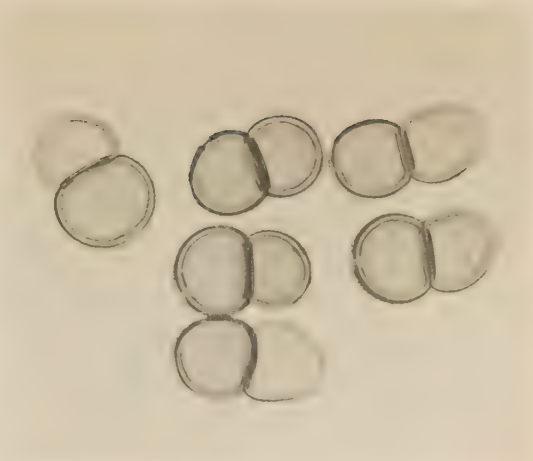
No. 112. Puccinia gigantea Karst. On Chamaenerion angustifolium, Canada. x250.

Epilobium.

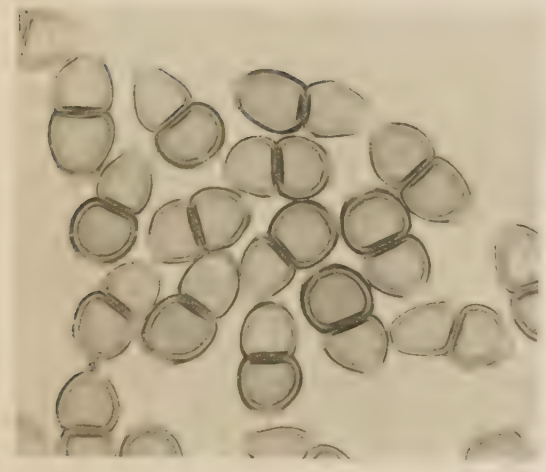
No. 113a. Puccinia Epilobii-tetragoni (DC) Wint. On Epilobum hirsutum, Germany, x500.
No. 113b. The same, on Epilobium paniculatum, Utah. x500.



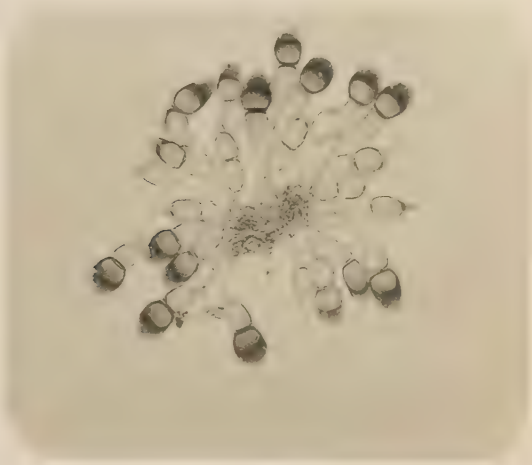
110a



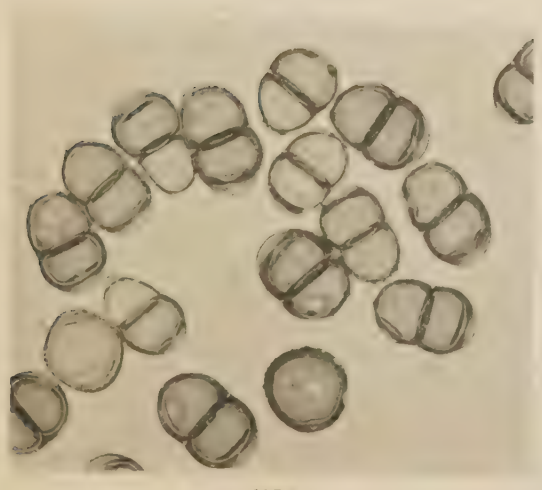
110b



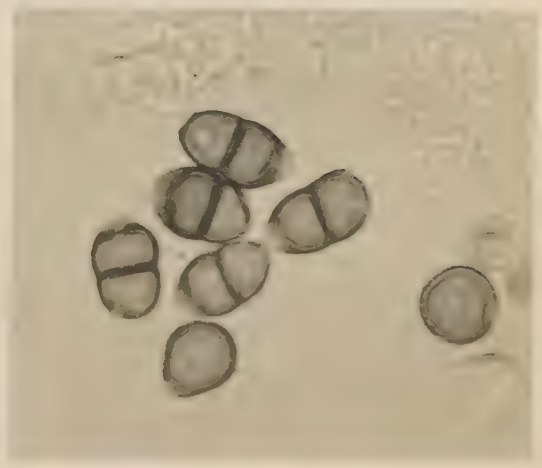
111



112



113a



113b

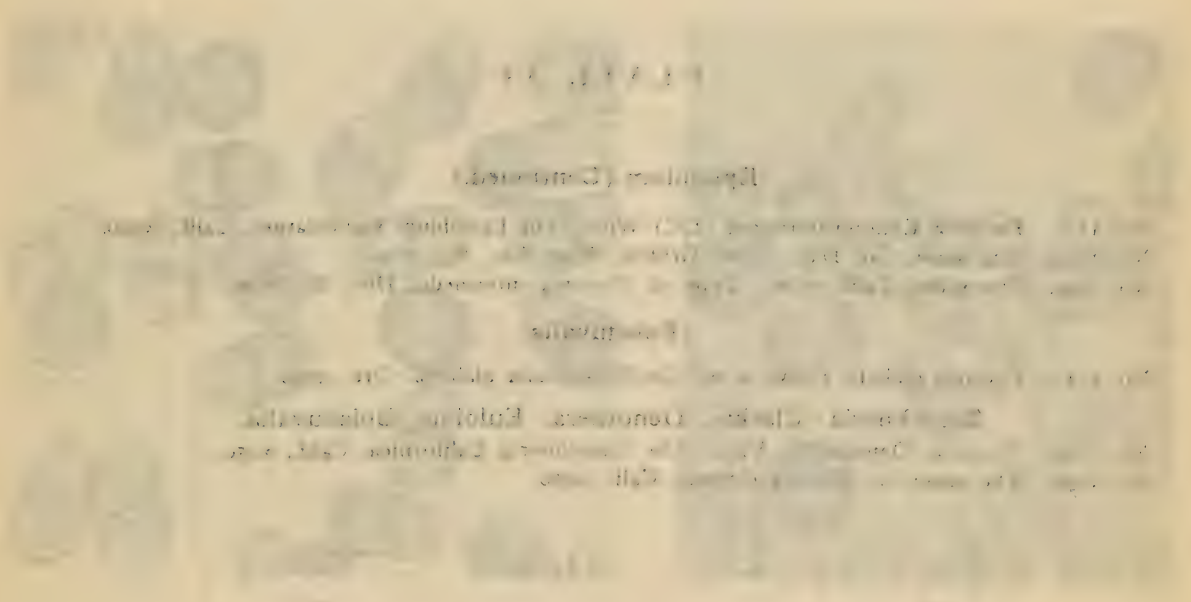


PLATE 34

Epilobium (Continued.)

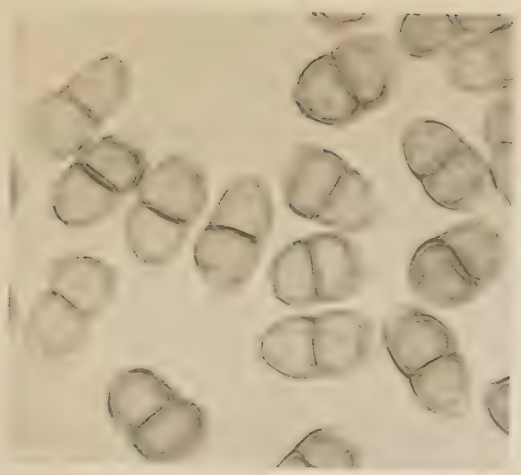
No. 113c. Puccinia Epilobii-tetragoni (DC) Wint. On Epilobium paniculatum, Calif., x500.
No. 113d. The same, So. Dak., x500. Griffith, West Am. Fg. *383a*.
No. 113e. The same, Calif. x500. Type of Puccinia intermedia Diet. & Holw.

Boisduvalia.

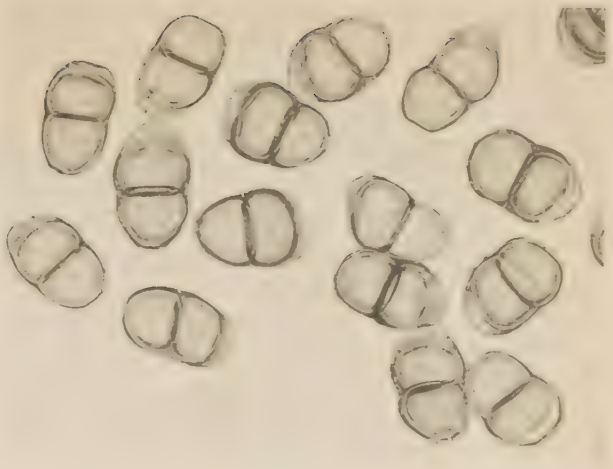
No. 114. Puccinia glabella Holw. n. sp. On Boisduvalia glabella, Ore. x500.

Zauschneria. Clarkia. Oenothera. Eulobus. Boisduvalia.

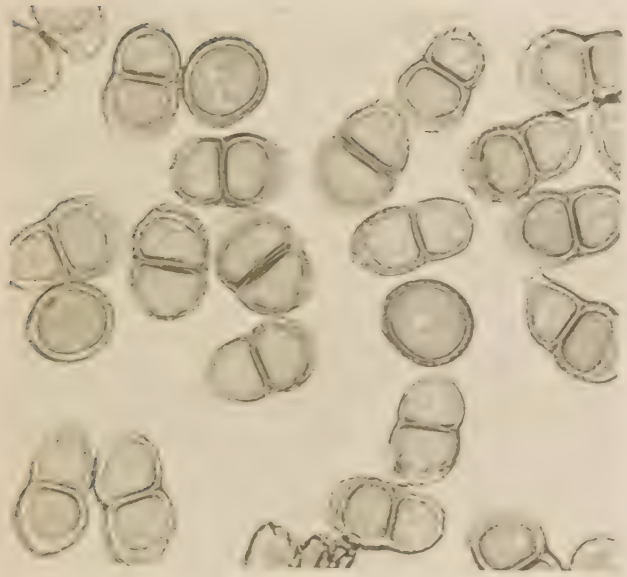
No. 115a. Puccinia Oenotherae Vize. On Zauschneria Californica, Calif., x250.
No. 115b. The same, on Clarkia elegans, Calif. x250.



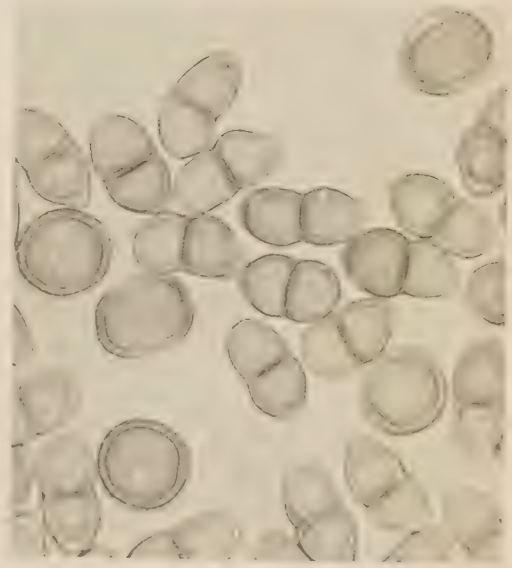
113c



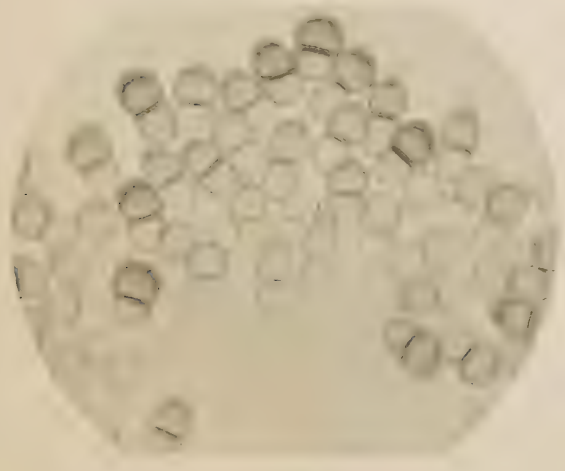
113d



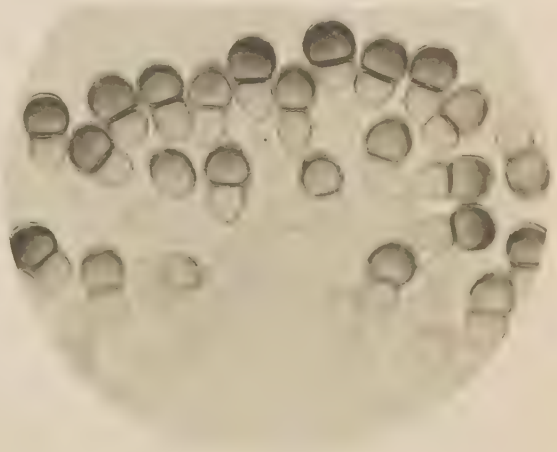
113e



114



115a



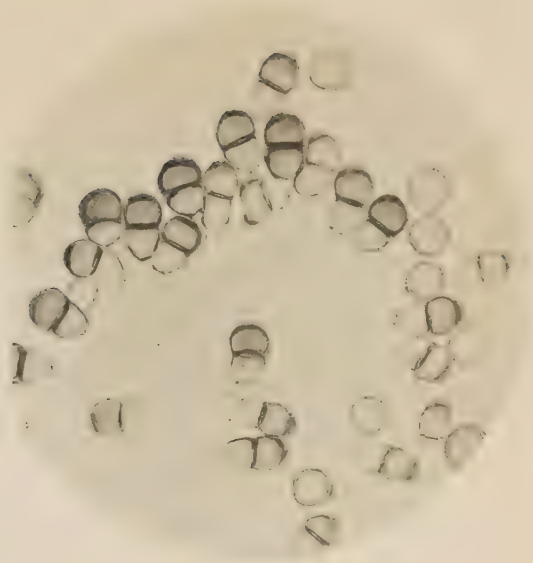
115b

PLATE 35

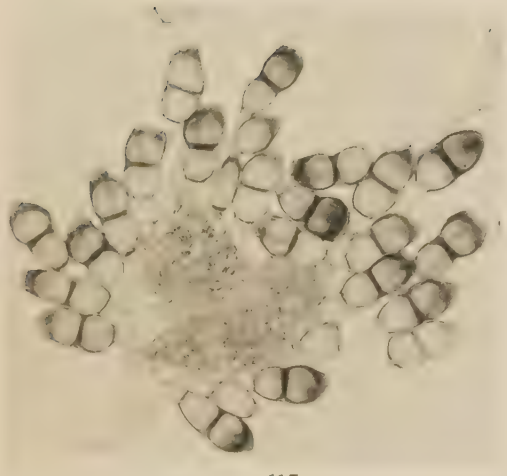
Zauschneria. Clarkia. Oenothera. Eulobus. Boisduvalia. (Continued.)

No. 115c. Puccinia Oenotherae Vize. On Oenothera hirtella, Calif., x250.
No. 115d. The same, on Oenothera micrantha, Calif. Elmer, No. 3192, x250.
No. 115e. The same, on Oenothera strigosa, Calif. x250.
No. 115f. The same, on Oenothera bistorta, Calif. x250.
No. 115g. The same, on Boisduvalia Torreyi Calif. x250. Type of Puccinia Boisduvaliae Peck.
No. 115h. The same, on Eulobus Californicus, Calif. x250. Type of Puccinia Eulobi Diet. & Holw.

115c

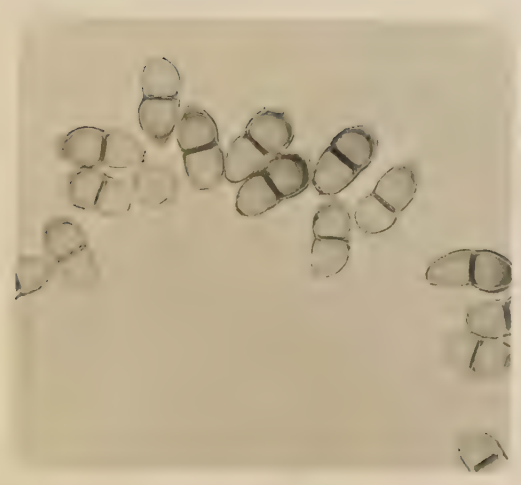


115d

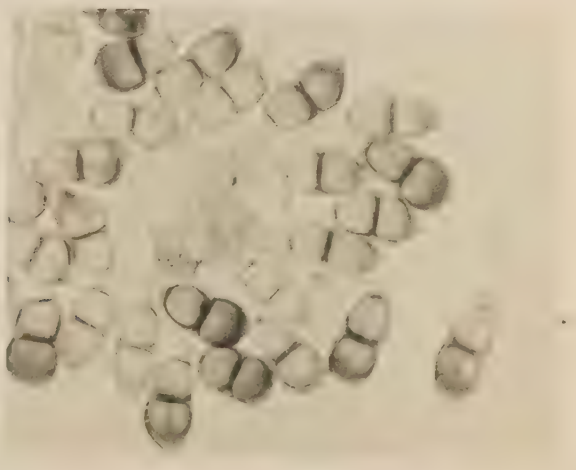


115e

115f



115g



115h

PLATE 36

Taraxia.

ONAGRACEAE (Continued.)

No. 116. Puccinia heterantha E. & E. On Taraxia ovata Calif. x250.

Gayophytum.

No. 117. Puccinia Gayophyti Billings. On G. ramosissimum, Ariz. x500.

Circaea.

No. 118a. Puccinia Circaeae Pers. On C. alpina, Mich. x250.
No. 118b. The same, winter spores, on C. Lutetiana, Iowa, x250.

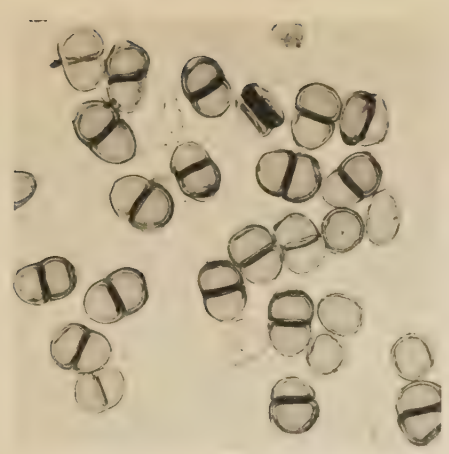
Fuchsia.

No. 119. Puccinia Fuchsiae Syd. & Holw. From type specimen, x250.

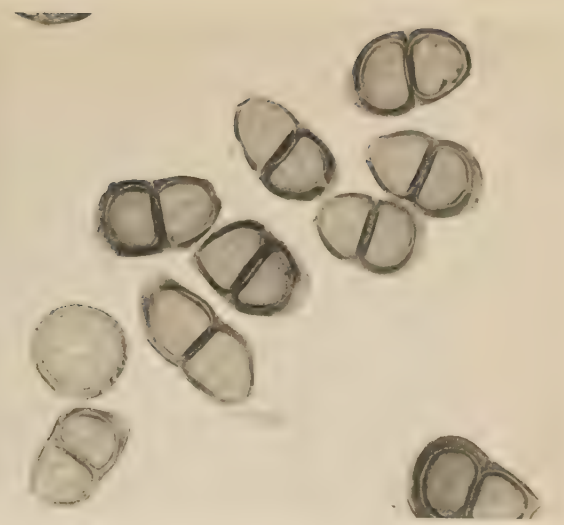
HALORRHAGIDACEAE.

Proserpinaca.

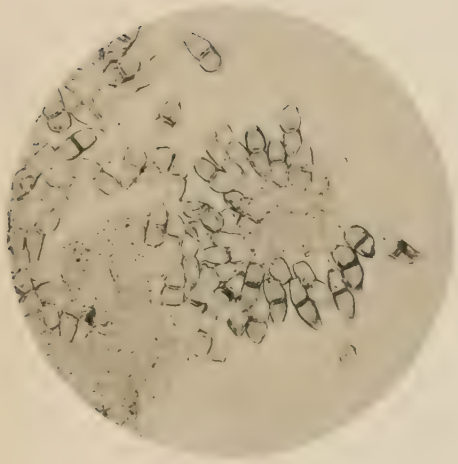
No. 120. Puccinia Proserpinacae Farlow. On P. palustris, Wisc. x250.



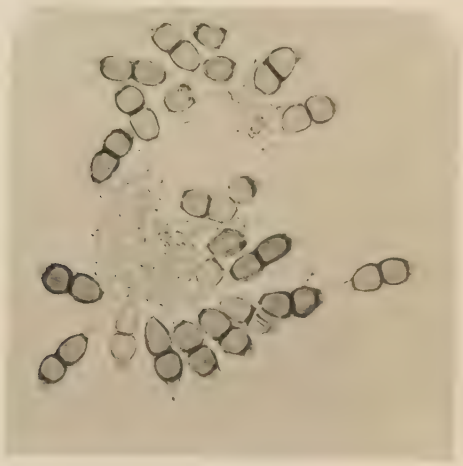
116



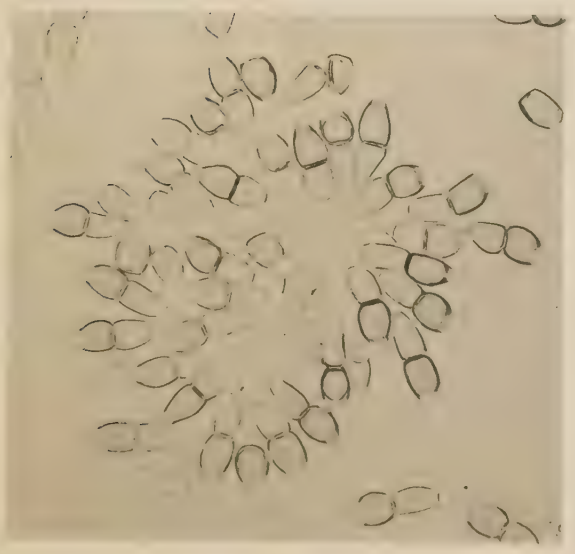
117



118a



118b



119

120

North American Uredineae

E. W. D. Holway

Vol. I. Part IV.

Genus Puccinia.

Araliaceae. Umbelliferae. Cornaceae.

Minneapolis, Minnesota
Issued June 11, 1913

ARALIACEAE.

PANAX. (ARALIA).

121. Puccinia Araliae E. & E.

Jour. Mycol. 6:120. 1891.

III. Sori amphigenous, dark brown, scattered or crowded into small groups ⅓mm. in diameter, elongated on the stems and petioles, surrounded by the ruptured epidermis, affected leaves more or less yellow; teleutospores brown, smooth, broadly elliptical to oblong, wall uniformly 2μ thick, mostly rounded at both ends with the cells of the same shape and size, rarely somewhat angular or irregular with the apex obtusely pointed, germ-pore of the upper cell at the apex or more or less to one side, that of the lower cell rarely at the septum, mostly depressed ⅓-½, occasionally near the pedicel, 27—37×18—25μ; pedicel up to 45μ long, hyaline, fragile.

On Panax trifolium L. Mass.

Photo: No. 121. From the type ×500.

Type: "On Ginseng (Panax trifolium), Massachusetts, May 1888, Miss C. H. Clark and M. C. Carter." Known only from the type locality.

UMBELLIFERAE.

HYDROCOTYLE.

122. Puccinia Hydrocotyle (Lk.) Cke.

Grev. 9:14. 1880.

Syn: Caeoma Hydrocotyles Lk. Linnc, Sp. Pl. 6²:22, 1825.
Uredo Hydrocotyles Mont. Gay, Hist. Chile 8:50. 1852.
Uredo Bonariensis Speg. An. Sc. Cient. Argent. 9:171. 1880.
Trichobasis Hydrocotyle Cke. * Seem. Jour. Bot. 2:344. 1864.

I. Unknown.

II. Uredosori amphigenous, more abundant on the upper surface, cinnamon brown, scattered quite evenly or rarely in small groups, long covered by the epidermis, pulverulent when fully mature; uredospores globose to elliptical, yellowish-brown, evenly echinulate, wall uniformly 2μ thick, 24—32×22—28μ; germ-pores 2, equatorial, prominent.

III. Teleutosori like the uredosori, dark brown to black, finally pulverulent; teleutospores smooth, yellowish-brown, elliptical to oblong, usually rounded at both ends, rarely with lower cell narrowed to the pedicel, germ-pore of the upper cell at the apex, that of the lower cell about the middle, each with a broad flat papilla, apex rarely slightly thickened, often somewhat constricted at the septum, 34—42×22—28μ; pedicel short, hyaline, fragile, often inserted laterally.

On various species of Hydrocotyle, Ala., Fla., Calif., Mex.

Photo: No. 122a. Uredospores from a Florida specimen, ×500.
No. 122b. Teleutospores from the same, ×500.

Type: "Habitat in Hydrocotyles specie Brasiliae Lect. propre Rio de Janiero."

Lindroth says of the teleutospores that they are covered with scattered, round, low tubercles. They are, however perfectly smooth, the supposed tubercles being light-reflecting particles in the cells. These show in the photographs.

Teleutospores appear to be rarely formed. An aecidium from S. America has been described as belonging to this species, but the writer has made a careful search for it many times, at different seasons, without success.

Exsiccati: Nelson, Rocky Mt. Herb. *2333*; Ellis, N. A. F. *1482*; Seymour and Earle, Econ. Fungi Supp. B. *12*.

SANICULA.

123. Puccinia marylandica Lindr.

Meddel. fr. Stockholms Högskolas bot. Inst. 4:(2). 1901.

O. Spermogonia seen only opposite the aecidia, subepidermal, yellowish, 90—110μ broad, ostiolar filaments about 45μ long.

I. Aecidia mostly hypophyllous on yellow or brown spots, in round groups or elongated on the veins; peridia projecting, white when dry, not reflexed; peridial cells adherent, finely verrucose, 24—40×20—30μ; aecidiospores globose or angular, hyaline, closely and finely verrucose 20—28×18—20μ.

II. Uredosori hypophyllous, minute, scattered, cinnamon-brown, spots yellow; uredospores yellow, echinulate, globose to ovate, wall 2μ thick, rarely somewhat thicker on one side, 20—26×18—24μ; germ-pores 3, equatorial, with low hyaline papillae.

III. Teleutosori amphigenous, small, chestnut-brown, soon naked and pulverulent; teleutospores elliptical to oblong, yellowish-brown, closely and evenly reticulated, wall uniformly 2μ thick, rounded at both ends, or with the lower cell narrowed to the pedicel, germ-pore of the upper cell at the apex, that of the lower ⅔—⅚ depressed, often near the pedicel, 30—44×20—24μ; pedicel hyaline, mostly shorter than the spore, fragile.

On Sanicula marylandica L., Wisc., Colo., Kan.; Sanicula sp. Ala., Mo., Va.

Photo: No. 123a. On Sanicula sp. Ala. Uredospores ×500.
No. 123b. On Sanicula marylandica, Wisc. Teleutospores ×500.
No. 123c. Teleutospores from the same, showing reticulations, ×500.

Type: Wisc. "Hab. in foliis Saniculae marylandicae; Amer. bor. (Davis)."

CHAEROPHYLLUM.

124. Puccinia Myrrhis Schw.

Proc. Am. Phil. Soc. 4:296. 1834.

II. Uredosori mostly hypophyllous and on the stems and petioles, light brown, round, scattered, firm, rarely confluent; uredospores subglobose, elliptical or ovate, pale yellow, wall thin, germ-pores 2, small, the upper part of the spore closely verrucose, the lower part smooth, 20—32×18—22μ.

III. Teleutosori amphigenous, dark-brown, soon pulverulent; teleutospores yellowish-brown, closely and evenly reticulated, ellipsoid, ovate, rarely oblong, sometimes rounded at both ends, more often slightly narrowed to the pedicel, more or less constricted, germ-pore of the upper cell at the apex, that of the other in the lower ⅓, often near the pedicel, without noticeable papillae, wall rather fragile, 32—40×18—22μ; pedicel up to the length of the spore, hyaline, fragile.

On Chaerophyllum procumbens (L.) Crantz. Ohio, Kentucky.

Photo: No. 124a. Teleutospores from Kellerm. Ohio Fungi *111*. ×500.
No. 124b. Uredospores from Kellerm. Ohio Fungi *112*. ×500.

Type: Penna. "In foliis et caulibus Myrrhis procumbentis. Bethl."

Exsiccati: Kellerm. Ohio Fungi *111*, *112*; Ellis N. A. F. *1940*; Raben.-Wint.-Paz. Fungi eur. *4027*.

Easily distinguished by the peculiar uredospores.

OSMORRHIZA.

125. Puccinia Osmorrhizae (Peck.) Cke. & Peck.

Rep. N. Y. State Mus. 29:73. 1878.

Syn: Caeoma Chelidonii Schw. Proc. Am. Phil. Soc. 4:291. 1834.
Aecidium Osmorrhizae Peck. Rep. N. Y. State Mus. 24:92. 1872.
Puccinia trifoliata E. & E. Bull. Torr. Bot. Club. 22:58. 1895.

O. Spermogonia subepidermal, scattered among the aecidia, sometimes very few, yellow, 120—136μ in diameter.

I. Aecidia mostly hypophyllous, in close irregular groups, often surrounding the stems and following the veins of the leaves, sometimes causing distortions, peridia poorly developed; aecidiospores orange, round to polygonal, closely verrucose, 18—30×16—24μ.

II. Uredosori mostly hypophyllous, cinnamon-brown, scattered, pulverulent; uredospores round to ovate, yellowish-brown, echinulate, 27—33×20—27μ; germpores mostly 3, rarely 2, papillae flat, hyaline, distinct, but not very prominent.

III. Teleutospores as in Puccinia Myrrhis, but in some specimens averaging a trifle longer.

On the various species of Osmorrhiza, from the Atlantic to the Pacific. On Erigenia bulbosa, London, Ontario.

Photo: 125a. Uredospores from O. brevistylis, Mich., ×500.

125b. Teleutospores from O. occidentale, Calif., ×500.
125c. Teleutospores from Erigenia bulbosa ×500.

The specimens on Erigenia, erroneously labeled as on Eryngium bulbosum, have aecidia and teleutospores only, and may yet prove to be a separate species. The material is very scanty and it has not been collected in any other locality. It is to be noted that No. 76, Puccinia trifoliata, is to be cancelled. The writer did not ascertain the error in the host plant until sometime after publication of Part 2.

Type: N. Y. "Leaves of Osmorrhiza brevistylis, North Greenbush, June."

Exsiccati: Ellis, N. A. F. *1040b, 1327, 1460*; Roumeguere, Fungi sel. *4609*; Kellerman, Ohio Fungi *110, 113, 114*; Sydow, Ured. *1347, 1778, 1932*; Garrett, Fungi Utah. *21, 32, 33, 188*; Ellis and Ev. Fungi Columb. *1770, 1772*; Rabenh.-Wint. Fungi eur. *4027b*; Barth. Fungi Columb. *3174, 3361*; Barth. N. Am. Ured. *51, 160*.

MUSINEUM. PSEUDOCYMOPTERUS.

126. Puccinia Musenii E. & E.

Bull. Torr. Bot. Club 27:61. 1900.

Syn: Puccinia Seymourii Lindr. Med. fr. Stockholms Högskolas bot. Inst. 4:(4). 1901.

III. Teleutosori amphigenous, mostly on the stems, at first covered by the grey epidermis, soon pulverulent, often 10mm. in length, black; teleutospores broadly elliptical or more rarely oblong, uniformly yellowish-brown, the apex slightly thickened, otherwise with the wall uniformly 2½μ thick, evenly verrucose, the tubercles distinct and mostly round; germ-pore of the upper cell at the apex, that of the lower at the septum, difficult to make out, 32—38×20—22μ; pedicel long, slender, hyaline, (sometimes brown close to the spore), very fragile, 1—3 septate, up to 200μ long.

On Musineum tenuifolium Nutt., Wyo.; Pseudocymopterus anisatus C. & R., Colo., Wyo: Oreoxis humilis Raf., Colo., 12,000 ft. (E. Bethel)

Photo: 126a. From the type collection, ×500.
126b. From Oreoxis humilis, Col. ×500.

Type: Wyoming. "On Musineum tenuifolium, Freezeout Hills, July 10, 1898, (Elias Nelson 4491.")

Exsiccati: Nelson, Flora of Wyo. *4491, 36, 7365*; Clements, Crypt. Form. Colo. *139*; Barth. N. Am. Ured. *50*.

DEWEYA. DRUDEOPHYTUM.

127. Puccinia Lindrothii Sydow.

Acta Soc. pro Fauna et Flora fennica 22:62. 1902.

Syn: Puccinia sphalerocondra Lindr. l. c.:63. 1902.

O. Not seen.

I. Aecidia mostly hypophyllous or on the stems and petioles, in small groups up to 5mm. in diameter, crowded and elongated on the stems; peridia white, irregularly laciniate, peridial cells mostly 27—35μ long, the outer wall smooth,

up to 12μ thick, the inner wall tuberculate, 5—7μ thick; aecidiospores round, elliptical or oblong, finely verrucose, 25—32×21—35μ.

III. Teleutosori black, amphigenous, more numerous on the under side of the leaves, early naked and pulverulent, surrounded by the ruptured epidermis, small, round, scattered, or elongated on the stems; teleutospores broadly elliptical to oblong, dark yellowish-brown, slightly constricted at the septum, wall uniformly 3—4μ thick, closely verrucose with distinct, mostly rounded tubercles, or on Deweya, the tubercles of the lower cell sometimes arranged longitudinally, or slightly united into ridges, germ-pore of the upper cell at the apex, that of the lower near the pedicel, 32—40×22—28μ; pedicel hyaline, fragile, as long as the spore or a little longer.

On Drudeophytum Hartwegi (Gr.) C. & R.; Deweya arguta T. & G. Calif.

Photo: 127a. On Drudeophytum Hartwegi, ×500.
127b. On Deweya arguta T. & G. ×500.

Type: "On Velaea Hartwegi (A. Gr.) C. & R.=Arracacia Hartwegi S. Wats. Berkeley 21. IV; 3. V. 94. W. C. Blasdale."

Exsiccati: Sydow, Ured. *877*, *878*; Rabenh.-Wint.-Paz. Fungi eur. *4022*. Barth. N. Am. Ured. *349*.

These have been referred to Puccinia Jonesii, but differ in the rather broader teleutospores which have much thicker walls. The aecidia differ very little.

ARRACACIA.

128. Puccinia imperspicua Sydow.

Monographia 1:361. 1902.

III. Teleutosori amphigenous, black, small, round to oblong, numerous, pulverulent; teleutospores elliptical to oblong, smooth, chestnut-brown, apex to 8μ thick, slightly constricted at the septum, rounded at both ends, wall about 4μ thick, 38—52×25—32μ; germ-pores prominent, that of the upper cell at the apex, of the lower close to the septum, each with a hyaline papilla; pedicel hyaline, stout, rather persistent, up to 100μ long.

On Arracacia multifida Wats. Pachuca and near the city of Mexico. (Rio Hondo.)

Photo: No. 128 From Pachuca, Fung. Columb. 2060 ×500.

Type: Mexico: "Hab. in foliis vivis Arracachae multifidae, Rio Hondo in Mexico (Pringle)."

Exsiccati: Ellis & Everh. Fungi Columb. *2060*.

The teleutospores are nearly all thickened over the apical pore and the pedicel is sometimes inserted laterally, in which case the germ-pores move to the upper side of the cells. Very abundant at Pachuca, the plants being completely covered with the fungus.

CICUTA.

129. Puccinia Cicutae Lasch.

*Klotsch. Herb. viv. myc. No. *787*. 1845.

Syn: Puccinia Cicutae Thuem. Bull. Soc. Imp. des Nat. Moscow 52:136. 1877.
Puccinia Cicutae majoris Wint. Rabenh. Krypt. Fl. 1:192. 1884.
Dicaeoma Cicutae (Lasch.) Kze. Rev. Gen. Pl. 3^2:468. 1898.

O. Spermogonia scattered between the aecidia, subepidermal, short conical, about 125μ in diameter, ostiolar filaments projecting, up to 35μ long.

I. Aecidia hypophyllous, yellow, small, in irregular groups surrounding a free space or crowded along the veins, peridia not reflexed, peridial cells polygonal, elliptical or irregular, wall thin, rather finely verrucose, from the size of the aecidiospores to twice their size; aecidiospores round or angular, finely verrucose 20—30×20—25μ.

II. Uredosori amphigenous, cinnamon-brown, small, scattered, surrounded by the ruptured epidermis, finally pulverulent; uredospores globose or obovate, yellowish-brown, evenly but distantly echinulate, wall uniformly 2½μ thick, germ-pores equatorial, 3, without papillae, 25—35×20—26μ.

III. Teleutosori amphigenous, dark brown, scattered or confluent in small groups, soon pulverulent; teleutospores mostly broadly elliptical, rarely oblong, rounded at both ends, brown, with irregular foldings and depressions, or with low irregular projections or ridges, soon becoming almost smooth in lactic acid, wall about 2μ thick, often constricted at the septum, germ-pores prominent, the upper at the apex, the lower from the middle of the cell to the pedicel, 30—42×22—28μ; pedicel hyaline, fragile, up to 60μ long.

On Cicuta vagans Greene, Nev.; Cicuta sp., Oregon; Cicuta occidentalis Greene, Calif.; Cicuta Curtissii C. & R., Fla.

Photo: No. 129a. Uredospores, from Cicuta occidentalis, Calif., ×500.
No. 129b. Teleutospores from Cicuta sp. Oregon, ×500.

Type: On Cicuta virosa, Europe, locality not ascertained.

Exsiccati: Griffiths. West Am. Fungi *376*.

ZIZIA.

130. Puccinia Ziziae E. & E.

Bull. Torr. Bot. Club. **22**:60. 1895.

O. Not seen.

III. Teleutosori epiphyllous, punctiform, mostly on yellow or light colored spots which are about 1mm. in diameter, scattered or rarely in small groups, soon naked, never confluent, chestnut-brown, pulverulent, surrounding epidermis prominent; teleutospores light yellowish-brown, mostly elliptical, rarely oblong, rounded at both ends, smooth or very rarely with one or two rows of small tubercles, wall uniformly 2μ thick, germ-pore of the upper cell at the apex, that of the lower cell mostly at the septum, occasionally depressed as far as the middle of the cell, each with a broad hyaline papilla, 28—44×20—24μ; pedicel about the length of the spore, hyaline, fragile.

On Zizia cordata. (Walt.) Koch. Pullman, Washington. (Piper.)

Photo: No. 130. Teleutospores, from the type collection, ×500.

Only the one collection is known to have been made.

CRYPTOTAENIA.

131. Puccinia Cryptotaeniae Peck.

Rep. N. Y. State Mus. 25:114. 1873.

Syn: Puccinia Astrantiae B. & C. Grev. 3:52. 1874.
Puccinia microica Ellis, Jour. Myc. 7:274. 1893.
Dicaeoma Cryptotaeniae (Pk.) Kuntze, Rev. Gen. Pl. 3^2:468. 1898.
Allodus Cryptotaeniae (Pk.) Arth. Result. Sci. Congr. Bot. Vienne 345. 1906.

O. Not seen.

I. Aecidia hypophyllous, minute, ¼—⅓mm. in diameter, scattered or in irregular groups, peridia not strongly developed, laciniate, slightly reflexed; aecidiospores thin-walled, globose or angular, very minutely punctate, appearing smooth except under high magnification, 15—17μ in diameter; peridial cells with the inner wall smooth, up to 7μ thick, the outer wall verrucose, 3—5μ thick, 18—30μ long.

III. Teleutosori on all parts of the plant, more numerous on the under side of the leaves, on small irregular brown, yellow, or red spots, or spots none, often concave opposite the sori, ⅕—¼mm. in diameter, chestnut-brown, long covered by the epidermis, at first opening by a minute pore, when old more or less pulverulent; teleutospores light yellowish-brown, smooth, rather variable in size and shape, elliptical to oblong, rounded at both ends or somewhat narrowed from the septum or irregularly angular, wall 2—2½μ thick, germpore of the upper cell at the apex or a little to one side, that of the lower close to the septum, with large rounded hyaline papillae, 26—44×13—20μ; pedicel slender, hyaline, fragile, about the length of the spore.

On Cryptotaenia Canadensis DC. Iowa, Penna. Wisc.

Photo: No. 131. Teleutospores from specimen collected at Decorah, Iowa, ×500.
Type: New York. "Leaves and petioles of honewort, Cryptotaenia Canadensis, common, June."
Exsiccati: Ellis & Everh. N. Am. Fungi ~~1459~~ *2412*; Sydow, Ured. *2020*.
Puccinia microica Ellis, described as on Sanicula, was an error in host.

LIGUSTICUM. OXYPOLIS. CARUM. ANGELICA. CONIOSELINUM.

132. Puccinia Ligustici E. & E.

Bull. Torr. Bot. Club 22:363. 1895.

Syn: Puccinia luteobasis E. & E. l. c. 24:457. 1897.
Dicaeoma Ligustici (E. & E.) Kuntze, Rev. Gen. Pl. 3^2:469. 1898.

III. Teleutosori mostly hypophyllous, in irregular groups or confluent for several centimeters on the stems and petioles, which are often more or less distorted, at first covered by the epidermis that in young specimens often firmly surrounds the sori which open at the top and appear like little cups, at length more or less confluent and pulverulent; spots none or yellow, teleutospores

mostly elliptical to oblong, yellowish-brown, smooth or with two to four rows of small tubercles, or with a few scattered tubercles, wall uniformly 2μ thick, germ-pores distinct, extremely variable in location, the upper from the apex to the septum, more often at or near the apex, the lower mostly in the lower half of the cell but varying from the septum to near the pedicel, papillae very small and flat or not apparent, $22—34\times16—22\mu$; pedicel hyaline, short, fragile.

On Oxypolis Fendleri (A. Gray) Heller. Colo: Carum Garrettii A. Nels. Utah; Conioselinum scopulorum (A. Gray) C. & R., Colo; Ligusticum sp., Colo. Utah, Wash., Br. Columb.; Angelica ampla A. Nelson, Colo.; Angelica Grayi C. & R., Colo. (Bethel)

Photo: No. 132a. Teleutospores from Conioselinum scopulorum, Colo., ×500.
No. 132b. Teleutospores from Ligusticum sp., Wash. ×500.
No. 132c. Teleutospores from Oxypolis Fendleri, Colo., ×500. Type collection.
No. 132d. Teleutospores from Carum Garrettii, Utah, ×500.
No. 132e. Teleutospores from Angelica ampla, Colo., ×500.
No. 132f. Teleutospores ofPuccinia Bistortae from Polygonum bistortoides, Colo., ×500.

Type: Colorado. "On leaves of Ligusticum scopulorum Gray, Sangre de Christo Mts. alt. 10,000 ft. July 1888, Rev. C. H. Demetrio No. 201." Error in host, which is Oxypolis Fendleri (A. Gray) Heller.

Exsiccati: Clements, Crypt. Form. Colo. *321, 322*; Baker, Earle & Tracy, Plants So. Colo. *1064*, said to be on Glycosoma occidentalis but is some Ligusticum; Garrett, Fungi Utah. *57*. Clements *322* is said to be on Angelica Grayi but appears to be Oxypolis Fendleri.

The type specimen of Puccinia luteobasis could not be found in the Ellis Herbarium. Specimens sent by the collector said to be on the same host were on Conioselinum scopulorum, and while more of the spores are oblong than on the other hosts, all the other characters are the same. The sori in different collections vary considerably, some very soon becoming pulverulent. Others remain surrounded by a firm and heavy layer of the epidermis and hyphae. These firm sori occur on Carum and Oxypolis also. It will be noticed from fig. 133f that the teleutospores of Puccinia Bistortae are absolutely identical with those of Puccinia Ligustici. An aecidium has been collected at Mt. Ranier on Ligusticum agreeing in every respect with specimens on Angelica collected by Juel in Sweden connected with Puccinia Polygoni-vivipari Karst. See note under No. 53.

Puccinia Aegopodii (Schum.) Lk., of Europe is very much like this species, but the teleutospores have the germ-pore of the upper cell at the apex and that of the lower cell nearly always at the septum, only rarely somewhat depressed, and the papillae are large and hemispherical.

TAENIDIA.

133. Puccinia bullata (Pers.) Wint.

Rabenh. Krypt. Flora 1:191. 1884.

Syn: Uredo bullata Pers. *Obs. 1:98. 1796.
Bullaria Umbelliferarum DC. Flore franc. 2:226. 1805.
Dicaeoma bullatum (Pers.) Kuntze, Rev. Gen. Pl. 3^2:468. 1898.
Bullaria bullata (Pers.) Wint. Arth. Result. Sci. Congr. Bot. Vienne 346. 1906.

O. Spermogonia and primary spores not seen.

II. Secondary uredosori mostly hypophyllous, cinnamon-brown, small, round, scattered on small irregular yellow spots; uredospores light to dark brown, broadly elliptical to oblong or obovate, evenly but not closely echinulate, wall uniformly 3—4μ thick, sometimes a little thickened at the ends; germ-pores 3—4, more often 3, papillae not usually conspicuous, 30—38×25—32μ.

III. Teleutosori hypophyllous, black, small, scattered, surrounded by the ruptured epidermis; teleutospores following in the uredosori, later forming separate punctiform sori, chestnut-brown, smooth, rather irregular in form, oblong, obovate or elliptical, rounded or narrowed from the septum, wall uniformly 2½μ thick, 30—44×20—28μ; germ-pores prominent, the upper mostly at the apex, the lower depressed ⅓—½ or near the pedicel, with conspicuous hyaline papillae; pedicel short, fragile, hyaline.

On Taenidia integerrima (L) Drude. N. Y. Wisc.

Photo: 133a. Uredospores from the Wisconsin specimen ×500.
133b. Teleutospores from the same ×500.

Type: Europe, on some Umbelliferous plant.

Exsiccati: Ellis & Everh. Fungi Columb. *1771.*

The uredospores of European specimens are more often thickened at the apex, but otherwise agree with ours. The teleutospores often show a few peculiar longitudinal folds or ridges; these show in the photographs.

ANGELICA.

134. Puccinia Angelicae (Schum.) Fckl.

Jahrb. Nassau. Vereins f. Naturk. **23**:(52) 1869.

Syn: Uredo Angelicae Schum. Enum. Pl. Saell, **2**:233. 1803.
Puccinia Archangelicae Blytt. *Christiania Vid. Selsk. Forhandl. :51. 1896.

O. Spermogonia, and primary uredosori not seen.

II. Secondary uredosori amphigenous, small, scattered, chestnut-brown; uredospores light yellowish-brown, obovate to elliptical, 5—12μ thick at the apex, evenly echinulate, 27—37×22—27μ; germ-pores 3, equatorial, with broad hyaline papillae.

III. Secondary teleutosori amphigenous, dark brown, small, scattered, often thickly covering the leaves, soon pulverulent; teleutospores smooth, brown, usually elliptical to oblong, rarely clavate, sometimes more or less irregular, the lower cell often narrowed to the pedicel, somewhat constricted at the septum; wall of uniform thickness, rarely slightly thickened at the apex; germ-pores variable, the upper more often at the apex but sometimes more or less to one side or even considerably depressed, the lower mostly in the lower part of the cell but varying from the septum to the pedicel, 30—52×20—25μ; pedicel hyaline, short, fragile.

On Angelica genuflexa Nutt. Oregon; Washington.

Photo: No. 134a. Uredospores from the Washington specimen, ×500.
No. 134b. Teleutospores from the Oregon specimen. ×500.

The specimens at hand do not show the primary spore forms which in the uredostage have spermogonia, the primary teleutospores following in the uredosori and soon filling them.

The Oregon specimens were found on herbarium specimens of the host, collected at Woodburn by Thos. Howell, Sept. 1885. Lindroth mentions the same collection but refers it to Puccinia Ellisii.

135. Puccinia Ellisii De Toni.

Sacc. Syll. 7:651. 1888.

Syn: Puccinia Angelicae E. & E. Bull. Washb. Lab. 1:3. 1884.
Puccinia Bakeriana Arth. Bull. Torr. Bot. Club. 31:3. 1904.

II. Uredosori hypophyllous, punctiform, light brown, scattered; uredospores broadly elliptical, rarely obovate, yellowish-brown, covered with short conical tubercles, thickened at each end up to 7μ, germ-pores equatorial, mostly 3, sometimes 4, papillae quite prominent or sometimes inconspicuous, 34—45×24—35μ.

III. Teleutosori like the uredosori but darker brown; teleutospores broadly elliptical to oblong, mostly rounded at both ends, cinnamon-brown, very slightly constricted wall uniformly 2μ thick, covered with round prominent tubercles, upper germ-pore at the apex, the lower close to the septum, papillae not conspicuous, 34—48×22—30μ; pedicel hyaline, fragile, short.

On Angelica genuflexa Nutt., Washington; A. tomentosa Wats., Calif.; Angelica sp., Montana.

Photo: No. 135a. Uredospores from Angelica genuflexa, Ellis N. A. F. *1449*, ×500.
No. 135b. Teleutospores from the same, ×500.

Type: Washington. No doubt the collection distributed in Ellis N. A. F. *1449*. The host is not given in the description, only the locality, "Falcon Valley."

Exsiccati: Ellis N. A. F. *1449*.

136. Puccinia poromera n. sp.

III. Teleutosori amphigenous, on round irregular dead spots, minute, scattered, or clustered, elongated and confluent on the veins, petioles and stems, dark brown, ruptured epidermis prominent; teleutospores variable in size, smooth, cinnamon-brown, elliptical to oblong, mostly rounded at both ends, occasionally a little angular, membrane uniformly 1½μ thick, the germ-pores of both cells nearly always at the septum, each with a prominent hyaline papilla, 25—42×15—26μ; pedicel hyaline, fragile, short.

On Angelica dilatata A. Nels. Utah. A. O. Garrett.

Photo: No. 136. ×500.

Exsiccati: Garrett, Fungi Utah. *190*.

The species is readily distinguished by the unusual position of the germ-pores. No spermogonia or other spores forms were found. The sori are sometimes extremely minute, containing only a few spores.

PTERYXIA. AULOSPERMUM. CYNOMARATHRUM.

137. Puccinia Cymopteri Diet. & Holw.

Bot. Gaz. 18:255. 1893.

Syn: Puccinia Traversiana Syd. Monogr. Ured. 1:889. 1904.

O. Not found.

I. Aecidia as in Puccinia Jonesii.

III. Teleutosori amphigenous, dark brown, small, elliptical, at first covered by the epidermis, soon pulverulent; teleutospores elliptical to oblong, brown, or yellowish-brown when not fully mature, usually rounded at both ends, sometimes more or less narrowed from the septum or a little angular, wall uniformly 2—2½μ thick, very minutely punctate, or with low minute tubercles, either isolated or more or less united; germ-pore of the upper cell at the apex, that of the lower cell in the lower one-third, mostly close to the pedicel, papillae low, flat, light brown, sometimes not apparent, 32—40×20—27μ, rarely up to 47μ long; pedicel hyaline, short, fragile.

On Pteryxia terebinthina (Hook.) C. & R., Calif.; Pteryxia calcarea (Jones) C. & R. Wyoming; Aulospermum purpureum (Wats.) C. & R. and Aulospermum Betheli Osterh., Colo.; Cynomarathrum Eastwoodiae C. & R., Colo.

Photo: No. 137a. Teleutospores from the type, ×500.
No. 137b. Teleutospores from Aulospermum purpureum, ×500.
No. 137c. Teleutospores from Cynomarathrum Eastwoodiae, ×500.

Type: On Cymopterus terebinthinus T. & G. Kings River Canon, Calif.

Exsiccati: Nelson, Plants of Wyoming *327*; Carleton, Ured. Am. *3*; Baker, Plants West Central Colo. *272*.

The dry teleutospores of the type are distinctly tuberculate, soon appearing smooth in lactic acid; those of the other specimens are minutely punctate. It is probably only a form of Puccinia Jonesii, to which it has been referred.

PSEUDOCYMOPTERUS.

138. Puccinia Pseudocymopteri n. sp.

O. Not found.

I. Aecidia minute, scattered or clustered in small groups, often thickly covering the stems and petioles, at first opening by a pore, finally forming shallow cups, peridia breaking irregularly, not reflexed; peridial cells strongly verrucose, oblong, 37—47×25—32μ, wall uniformly 5—6μ thick; aecidiospores orange, closely and strongly verrucose, round to oblong, 20—30×20—25μ.

II. Uredosori, cinnamon-brown amphigenous, minute, at first covered by the epidermis, at length pulverulent, confluent on the stems; uredospores pale brown, ovate to globose, echinulate, 27—32×22—25μ; germ-pores minute, very difficult to make out, apparently 4.

III. Teleutosori dark brown, amphigenous, small, round or oblong, scattered, often occurring with the aecidia, later following the uredosori on the leaves, long covered by the epidermis, finally pulverulent; teleutospores yellowish-brown, broadly elliptical, rather fragile, wall uniformly 1—1½μ thick, sub-reticulate or covered with low irregular ridges which are sometimes more or less longitudinal, germ-pore of the upper cell at the apex, that of the lower from near the middle to the pedicel, without papillae, 30—36×22—26μ; pedicel fragile, hyaline, not exceeding the spore.

On Pseudocymopterus montanus C. & R. Ouray, Colo., Bethel, (type); Eldora Colo., So. Wyoming; P. anisatis C. & R., Utah.

Photo: No. 138a. Uredospores, from the type, ×500.

No. 138b. Teleutospores from the type, ×500.

Several collections have aecidia and teleutospores only, but uredospores are abundant in the type specimens.

PRIONOSCIADIUM. COULTEROPHYTUM.

139. Puccinia Prionosciadii Lindr.

Meddel. fr. Stockholms Högskolas bot. Inst. 4:(5). 1901.

Syn: Puccinia Coulterophyti Diet. & Holw. Bot. Gaz. 31:335. 1901.

II. Uredosori punctiform, hypophyllous, opposite small irregular pale spots (or spots none on Prionosciadium), yellowish, not confluent but often thickly covering the leaves; uredospores globose, obovate, or elliptical, pale yellow or hyaline, wall very thin, apex strongly thickened up to 14μ, evenly but not closely covered with short conical spines; germ-pores possibly 3, not easily seen, 28—38×20—28μ, rarely up to 36μ long.

III. Teleutosori like the uredosori but dark brown to black, soon pulverulent; teleutospores broadly elliptical to oblong, dark brown, mostly rounded at both ends, sometimes a little angular, wall very thick, 4—6μ, minutely punctate; germ-pore of the upper cell mostly at the apex, that of the lower from the septum to the middle of the cell, often with large light brown papillae, 34—50×24—34μ; pedicel hyaline, fragile, about the length of the spore.

Mexico: On Coulterophytum laxum Rob.; C. Holwayi Rose; Prionosciadium dissectum C. & R.; P. Nelsoni C. & R.; P. Watsoni C. & R.

Photo: No. 139a. Uredospores from Coulterophytum laxum ×500.
No. 139b. Teleutospores from the same ×500.
No. 139c. Teleutospores from Prionosciadium Watsoni ×500.
No. 139d. Teleutospores from Coulterophytum Holwayi ×500.

Type: Mexico: "Hab. in foliis Prionosciadii Watsoni: (Herb. Lagerheim)"

Exsiccati: Sydow, Ured. *1827*; Vestergren, Micromycetes rar. sel. *866*; Barth. N. Am. Ured. *55, 258, 466*; Barth. Fungi Columb. *3463*.

Photographs 139a and 139b are from the type specimen of Puccinia Coulterophyti. The teleutospores are peculiar as they will not swell to natural size in boiling lactic acid without the addition of considerable water and then very slowly. The two central spores of 139c have not been affected by the acid and show the large globose papillae.

LEPTOTAENIA.

140. Puccinia asperior E. & E.

Bull. Washb. Lab. 1:3. 1884.

Syn: Puccinia Oregonensis Earle. Bull. N. Y. Bot. Garden 2:349. 1902.
Dicaeoma asperius (E. & E.) Kunze, Rev. Gen. Pl. 3^2:468. 1898.
Allodus Oregonensis Arth. Result. Sci. Congr. Bot. Vienne. 345. 1906.

I. Aecidia as in Puccinia Jonesii.

III. Teleutosori hypophyllous and on the stems and petioles, black, round to oblong, often confluent, scattered, long covered by the lead colored epidermis, finally

pulverulent; teleutospores elliptical, ovate-elliptical, or oblong, usually rounded at the ends, wall uniformly 2½μ thick, covered with large isolated round or angular tubercles 2μ in diameter, germ-pores indistinct, papillae quite small, the upper at the apex, the lower near the pedicel, 26—37×20—22μ; pedicel slender, hyaline, very fragile, up to 50μ long.

On Leptotaenia dissecta Nutt. (Ferula dissoluta Wats.) Calif. Wash. Oregon.

Photo: 140a. Teleutospores, from Californian specimen, ×500.
140b. Teleutospores from the type of Puccinia Oregonensis, ×500.

Type: Washington. "On Ferula dissoluta, June (No. 86.)"

This is very close to Puccinia Jonesii, but differs in its smaller teleutospores and larger, always isolated tubercles.

Puccinia Oregonensis was published as occurring on Sanicula but is on some Leptotaenia, probably L. dissecta.

LOMATIUM. LEPTOTAENIA. MUSINEUM.

141. Puccinia Jonesii Peck.

Bot. Gaz. 6:226. 1881.

Syn: Dicaeoma Jonesii (Peck) Kunze, Rev. Gen. Pl. 3²:469. 1898.
Allodus Jonesii (Peck) Arth. Result. Sci. Congr. Bot. Vienne 345. 1906.

O. Spermogonia amphigenous, scattered among the aecidia, often wanting, subepidermal, yellow, 90—100μ in diameter; ostiolar filaments hyaline, projecting, up to 55μ long.

I. Aecidia amphigenous, crowded, often distorting the stems; peridia, when well developed, coarsely laciniate, reflexed, peridial cells quite uniformly 25—35μ long, outer wall smooth, up to 12μ thick, inner verrucose, mostly 5—6μ thick; aecidiospores globose, angular or elliptical, wall thin, finely verrucose, 20—30μ in diameter.

III. Teleutosori black, at first associated with the aecidia, later separate, mostly hypophyllous, scattered, punctate to 2mm. in diameter, at first covered by the epidermis, soon pulverulent and often confluent; teleutospores elliptical, obovate, or oblong, brown, rounded at both ends, or the lower cell narrowed, wall uniformly 2—2½μ thick, strongly verrucose, the tubercles round, isolated or more or less united into ridges; germ-pore of the upper cell at the apex, that of the lower depressed two-thirds or more, often near the pedicel, without noticeable papillae, 25—40×18—24μ; pedicel hyaline, fragile, up to 50μ long.

On Lomatium platycarpum (Torr.) C. & R. Utah; L. orientale C. & R. Colo.; L. triternatum (Pursh.) C. & R., L. Suksdorfii (Wats.) C. & R., Wash.; Leptotaenia multifida Nutt., Wash., Utah, Colo., Alberta; Musineum Hookeri (Torr. & Gray) Nutt., Colo.; M. divaricatum (Pursh) C. & R., S. Dak.; Lomatium foeniculaceum (Nutt.) C. & R. Nebr.

Photo: No. 141a. Teleutospores from Lomatium triternatum, Wash. ×500.
No. 141b. Teleutospores from Leptotaenia multifida, Utah, ×500.
No. 141c. Teleutospores from Musineum Hookeri, Colo., ×500.

Type: Utah. "Living leaves of Ferula multifida and Peucedanum simplex."

Exsiccati: Ellis and Ev. N. Am. Fungi, *1448*, *1856*; Fungi Columb. *1460*, *1966*, *1967*; Sydow. Ured. *1929*, *1930*; Clements, Crypt. Form. Colo. *567*; Garrett, Fungi

Utah. *5, 6, 7, 8*; Barth. Fungi, Columb. *3846.*

Fig. 141c shows teleutospores from the same sorus, some of which are nearly smooth and others are strongly tuberculate. As no other collection is like this it may be that two forms are growing together.

CYNOMARATHRUM.

142. Puccinia Cynomarathri n. sp.

O. Spermogonia yellow, projecting, 100—160μ in diameter, on the leaves with the primary uredospores, often forming dense groups, 4—5mm. in diameter, or finally overgrown by the uredospores, ostiolar filaments 30—40μ long.

II. Primary uredosori cinnamon-brown, amphigenous, large, up to 10mm. in diameter, at first covered by the epidermis which remains prominent; secondary uredosori pulverulent, small 1—2mm. in length, elliptical; uredospores yellowish-brown, globose, elliptical or obovate, wall uniformly 2½μ thick, rarely a little thickened at the ends, evenly but not closely echinulate, 27—38×20—30μ; germ-pores equatorial, 2—3, mostly 3, with prominent hyaline papillae.

III. Teleutosori black, amphigenous, elliptical to oblong, long covered by the epidermis which remains prominent, finally pulverulent; teleutospores broadly elliptical to oblong, cinnamon-brown, rounded at both ends or more or less narrowed from the septum, often somewhat irregular and angular, slightly constricted at the septum, wall uniformly 2μ thick, closely and evenly verrucose, rarely slightly thickened at the apex, 37—42×22—30μ; germ-pore of the upper cell at the apex, that of the lower close to the septum; pedicel hyaline, fragile, about the length of the spore.

On Cynomarathrum Nuttallii (Gray) C. & R. Wasatch Mts. Utah, Garrett.

Photo: No. 142a. Primary uredospores from Garrett, Fungi Utah. 51, ×500.
No. 142b. Teleutospores from Garrett, Fungi Utah. 9, ×500.

Exsiccati: Garrett, Fungi Utah. *9, 51.*

The teleutospores are much like those of Puccinia Ellisii, but the uredospores are entirely different.

CORNACEAE.

CORNUS.

143. Puccinia acuminata Peck.

Report N. Y. State Mus. 23:57. 1873.

Syn: Puccinia porphyrogenita Curt. Thuem. Myc. univ. *545.* 1876.

III. Teleutosori hypophyllous, black, firm, round, scattered, 1—3mm. in diameter, spots red or reddish-brown, depressed opposite the sori, surrounding epidermis prominent. Teleutospores brown, smooth, clavate or oblong-clavate, apex obtusely acuminate, rarely rounded, often with an abrupt light colored pro-

jection from the center or more or less lateral, up to 15μ thick, constricted at the septum, narrowed to the pedicel, 50—62×16—22μ; pedicel light brown, firm, persistent, up to 40μ long; germ-pore of the upper cell near the apex, that the lower near the septum, inconspicuous.

On Cornus Canadensis L. From New York and New Hampshire to Vancouver Island and Alaska, doubtless wherever the host occurs. It is very abundant in the Canadian Mts. and Vancouver Island.

Photo: No. 143. From a Mt. Ranier, Wash., specimen ×250.

Exsiccati: Ellis, N. A. F. *1032*; Ellis & Everh. Fungi Columb. *1653*; Theum. Mycoth. univ. *545*; Seymour & Earle, Econ. Fungi *208*; Arth. & Holw. Ured. *14*.

PLATE 37

Aralia.

121. Puccinia Araliae E. & E. on Panax trifolium L., ×500.

Hydrocotyle.

122a. Puccinia Hydrocotyle (Lk.) Cke. on Florida specimen, ×500.

122b. Puccinia Hydrocotyle (Lk.) From the same, ×500.

Sanicula.

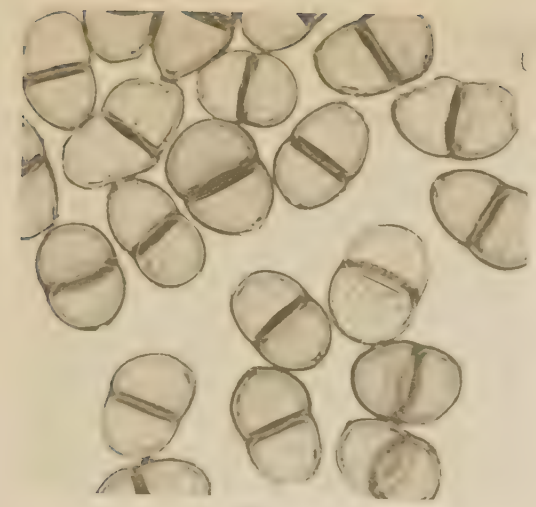
123a. Puccinia marylandica Lindr. On Sanicula sp., Ala., ×500.

123b. Puccinia marylandica. On Sanicula marylandica, Wisc., ×500.

123c. Puccinia marylandica. On Sanicula marylandica, Wisc., ×500.

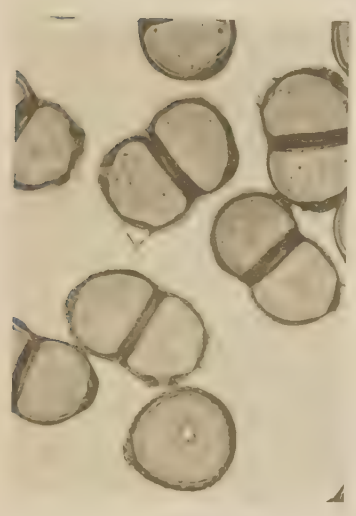
Chaerophyllum.

124a. Puccinia Myrrhis Schw. On C. procumbens, Ohio, ×500.

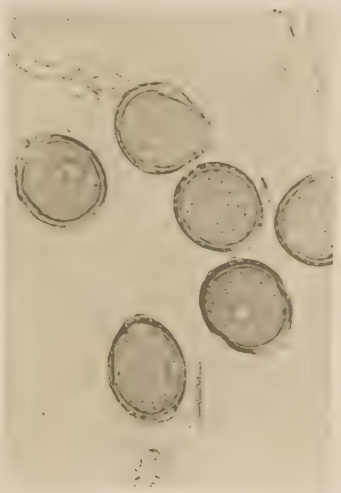


121

122 a

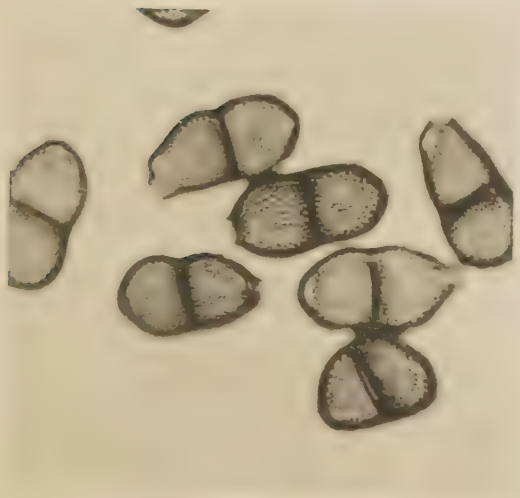


122 b

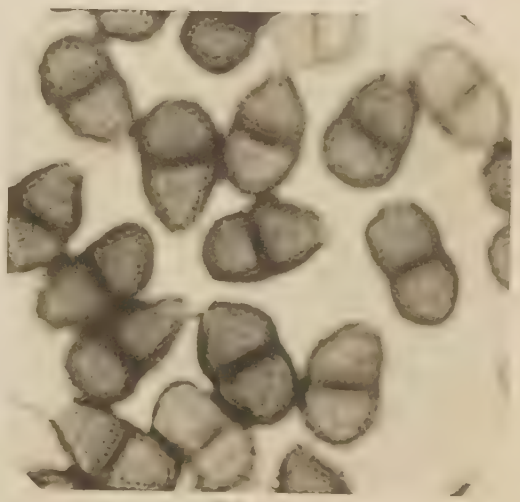


123 a

123 b



123 c



124 a

PLATE 38

Chaerophyllum.

124b. Puccinia Myrrhis Schw. On C. procumbens, Ohio, ×500.

Osmorrhiza.

125a. Puccinia Osmorrhizae (Pk.) C. & P. From Mich., ×500.

125b. Puccinia Osmorrhizae. From Calif., ×500.

125c. Puccinia Osmorrhizae. From Erigenia bulbosa, ×500.

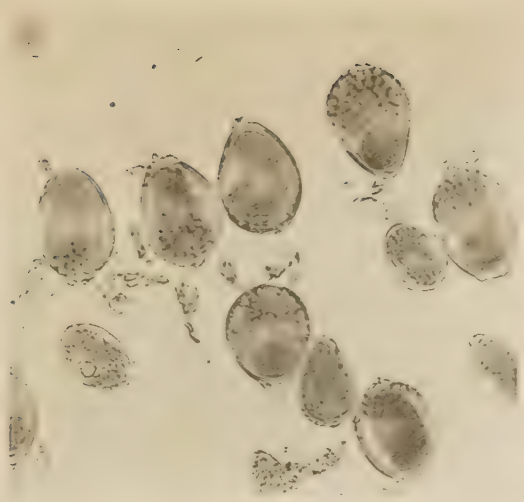
Musineum. Pseudocymopterus.

126a. Puccinia Musenii E. & E. Type, ×500.

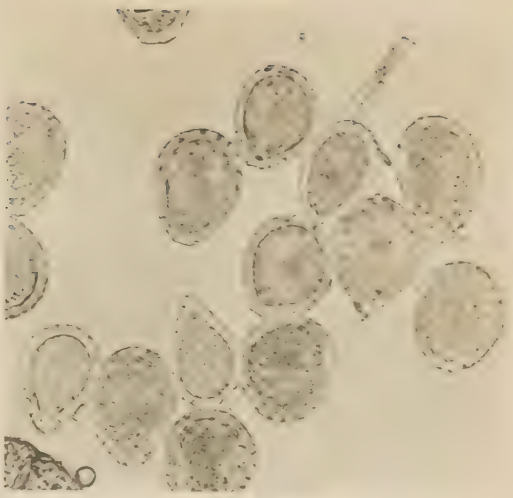
126b. Puccinia Musenii. From Oreoxis humilis, ×500.

Drudeophytum. (Velaea.)

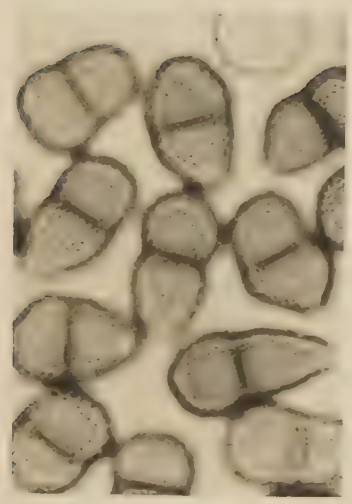
127a. Puccinia Lindrothii Sydow. From Sydow Ured. 878, ×500.



124 b



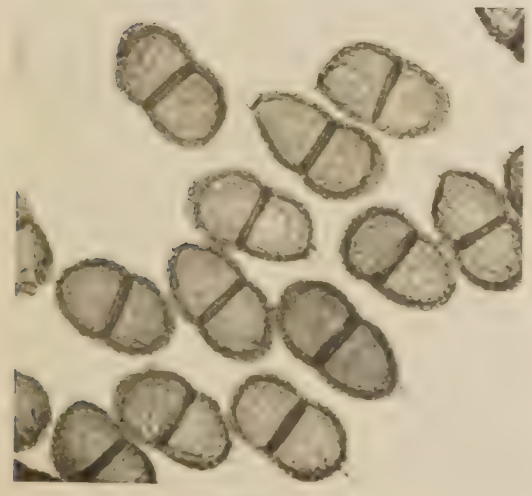
125 a



125 b

125 c

126 a



126 b

127 a

PLATE 39

Deweya. (Velaea.)

127b. Puccinia Lindrothii Sydow. ×500.

Arracacia.

128. Puccinia imperspicua Sydow. From Fungi Columb. 2060, ×500.

Cicuta.

129a. Puccinia Cicutae Lasch. From Cicuta occidentalis, Calif., ×500.

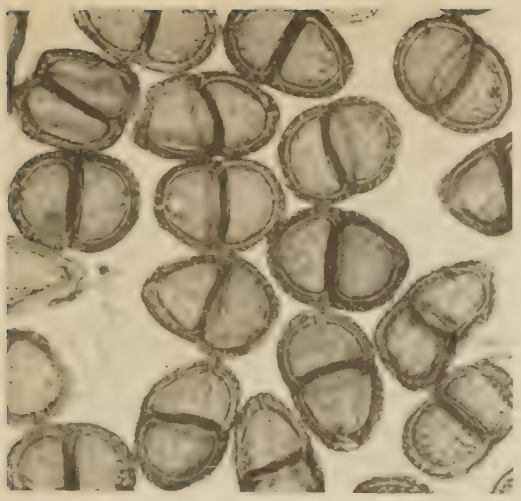
129b. Puccinia Cicutae. From Cicuta sp., Oregon., ×500.

Zizia.

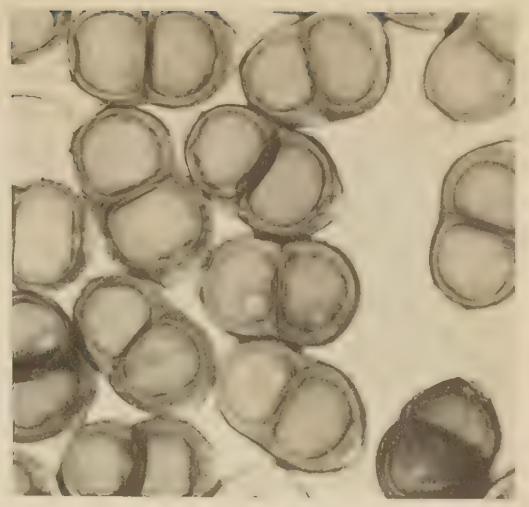
130. Puccinia Ziziae E. & E. From the type coll., ×500.

Cryptotaenia.

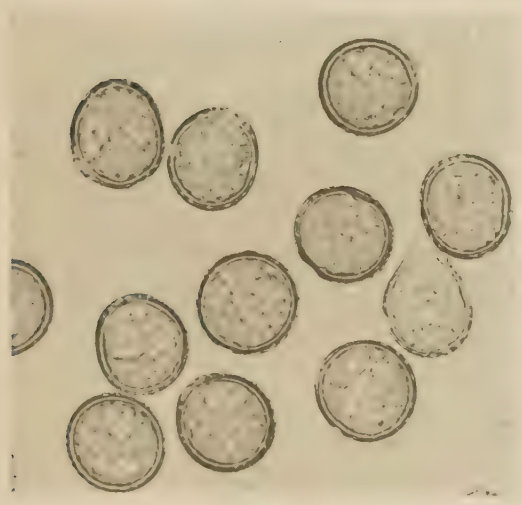
131. Puccinia Cryptotaeniae Pk. From Iowa specimen, ×500.



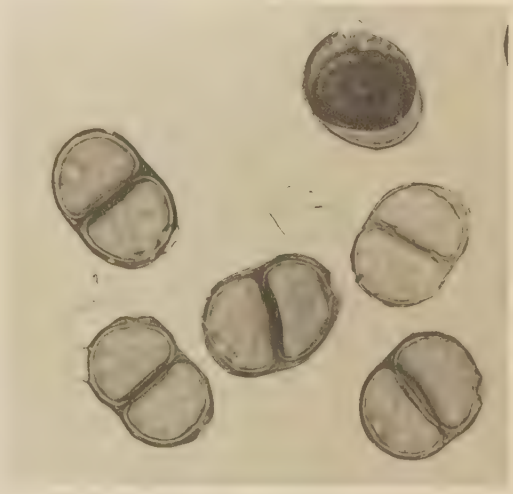
127 b



128



129 a



129 b

130

131

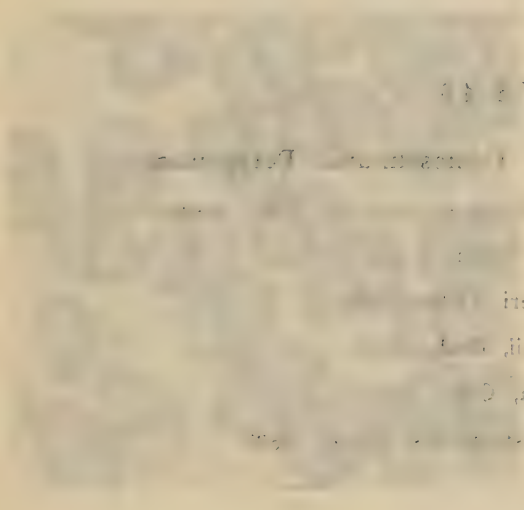


PLATE 40

Ligusticum. Oxypolis. Carum. Angelica. Conioselinum. Polygonum.

132a. Puccinia Ligustici E. & E. From Conioselinum scopulorum, Colo., ×500.

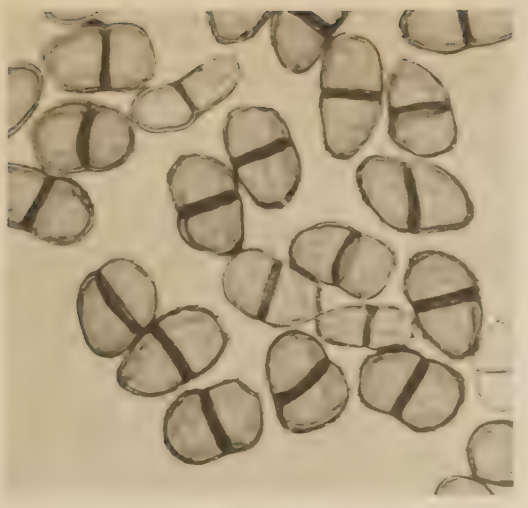
132b. Puccinia Ligustici. From Ligusticum sp., Wash., ×500.

132c. Puccinia Ligustici. From Oxypolis Fendleri, Colo., ×500.

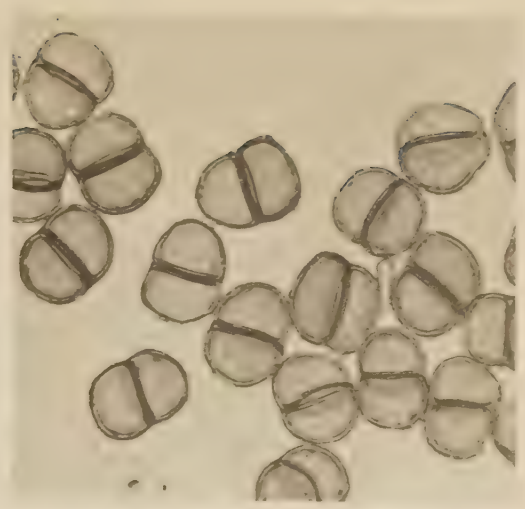
132d. Puccinia Ligustici. From Carum Garrettii, Utah, ×500.

132e. Puccinia Ligustici. From Angelica ampla, Colo., ×500.

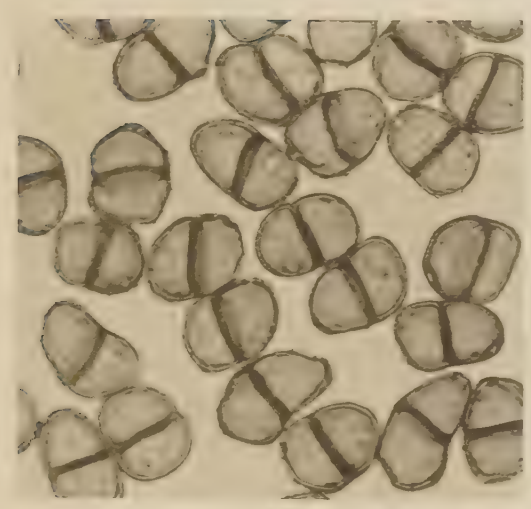
132f. Pucinnia Bistortae. From Polygonum bistortoides, Colo., ×500.



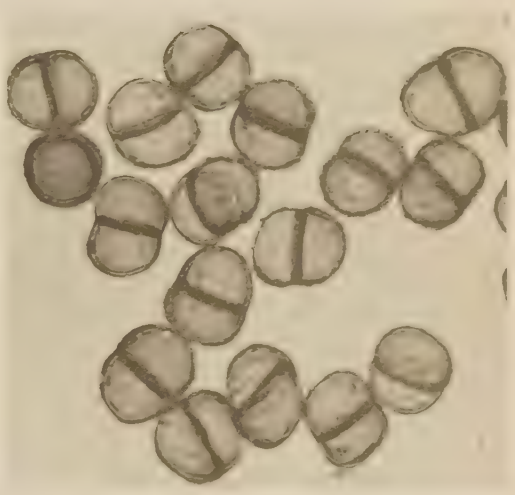
132 a



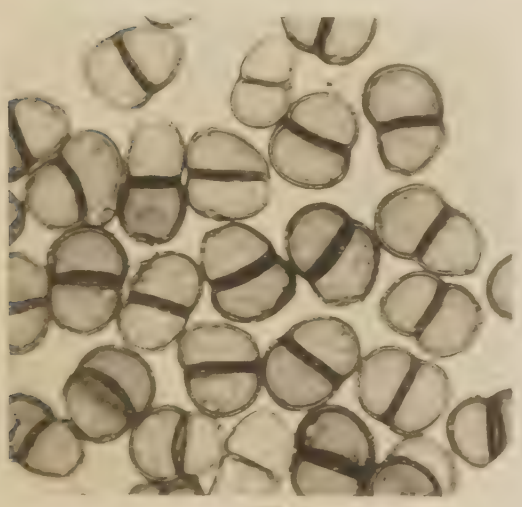
132 b



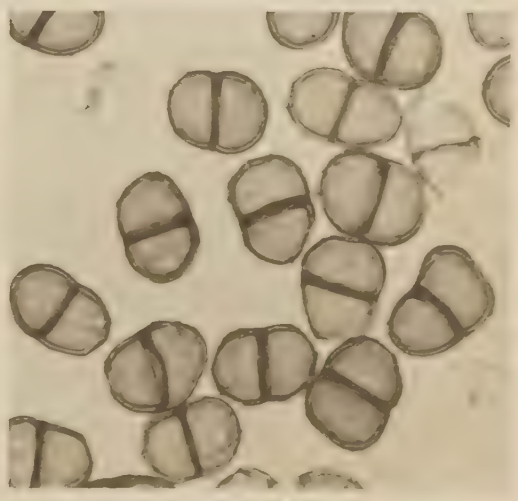
132 c



132 d



132 e



132 f

PLATE 41

Taenidia.

133a. Puccinia bullata (Pers.) Wint. From Wisc. specimen ×500.

133b. Puccinia bullata. From Wisc. specimen ×500.

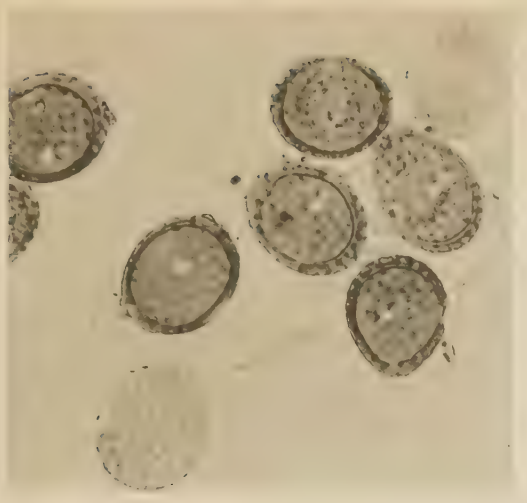
Angelica.

134a. Puccinia Angelicae (Schum.) Fckl. From Wash. spec., ×500.

134b. Puccinia Angelicae. From Oregon specimen, ×500.

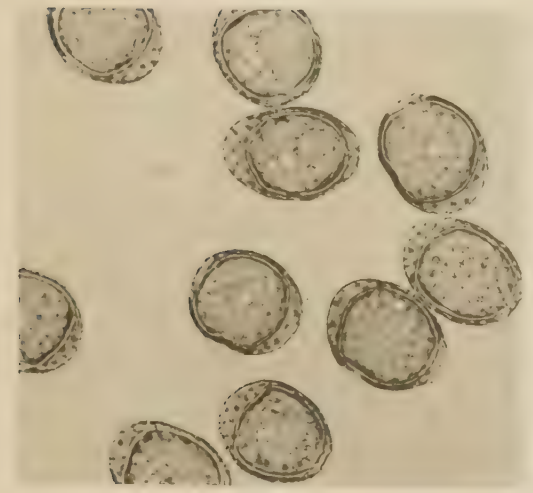
135a. Puccinia Ellisii De Toni. From Ellis N. A. F. 1449, ×500.

135b. Puccinia Ellisii. From same, ×500.



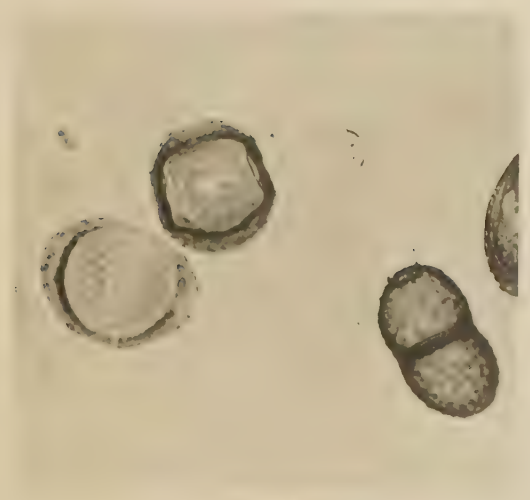
133 a

133 b



134 a

134 b



135 a

135 b

PLATE 42

Angelica.

136. Puccinia poromera Holway, Type, ×500.

Pteryxia. Aulospermum. Cynomarathrum.

137a. Puccinia Cymopteri D. & H. Type, ×500.

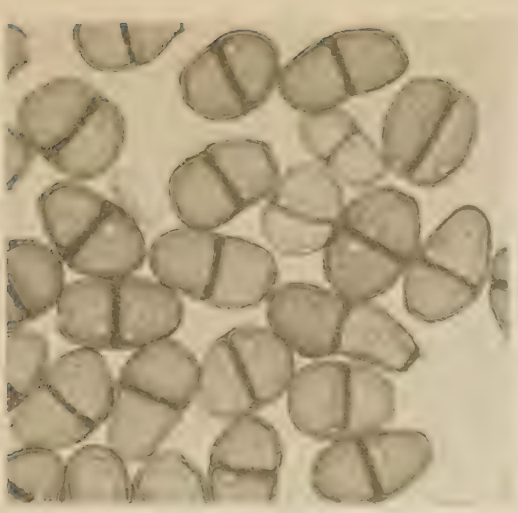
137b. Puccinia Cymopteri. From Aulospermum purpureum, ×500.

137c. Puccinia Cymopteri. From Cynomarathrum Eastwoodiae, ×500.

Pseudocymopterus.

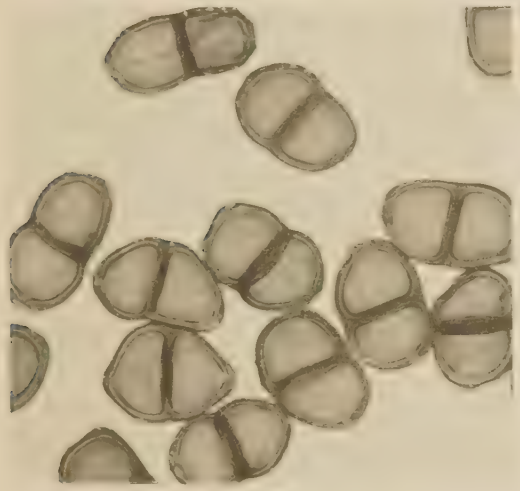
138a. Puccinia Pseudocymopteri Holway, Type, ×500.

138b. Puccinia Pseudocymopteri, Type, ×500.



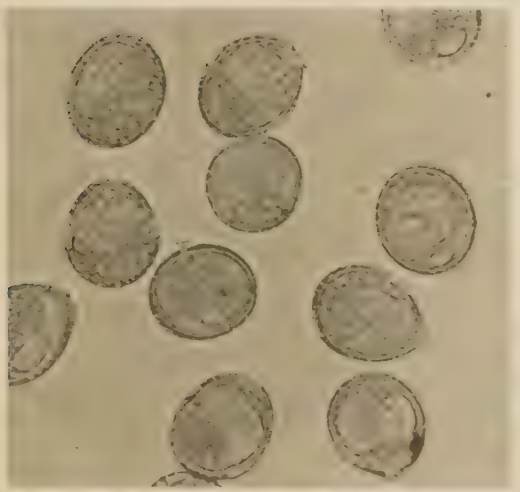
136

137 a

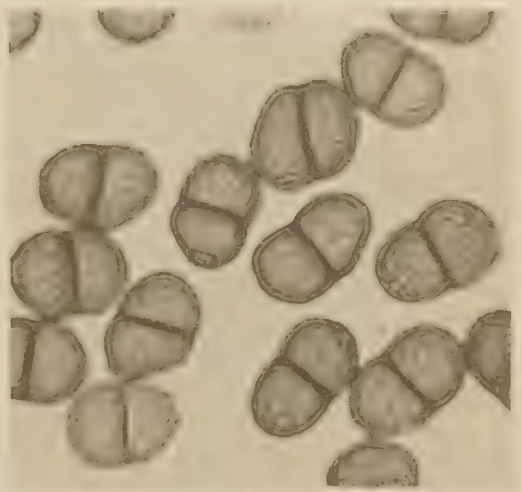


137 b

137 c



138 a



138 b

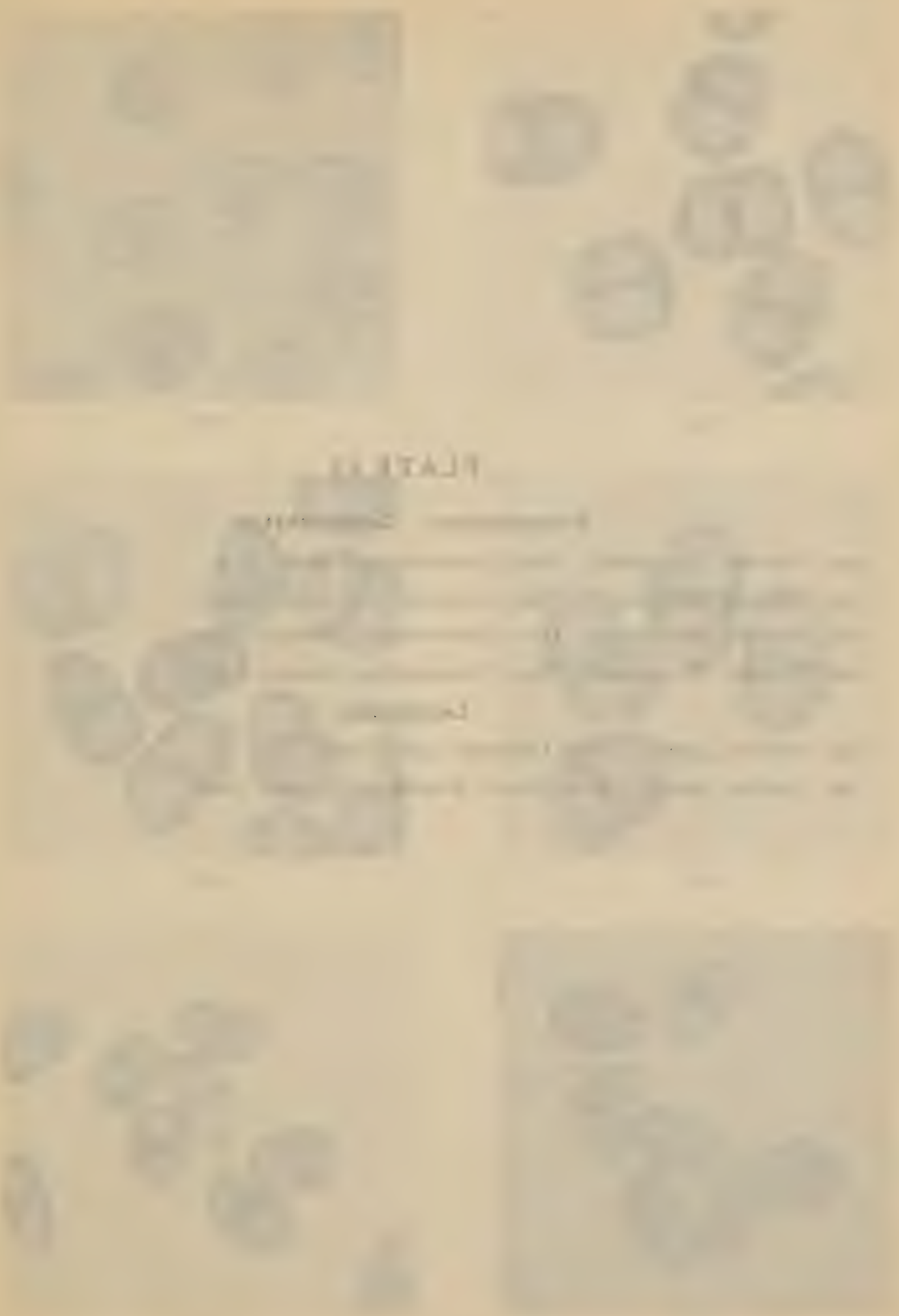


PLATE 43

Prionosciadium. Coulterophytum.

139a. Puccinia Prionosciadii. From Coulterophytum laxum, ×500.

139b. Puccinia Prionosciadii. From Coulterophytum laxum, ×500.

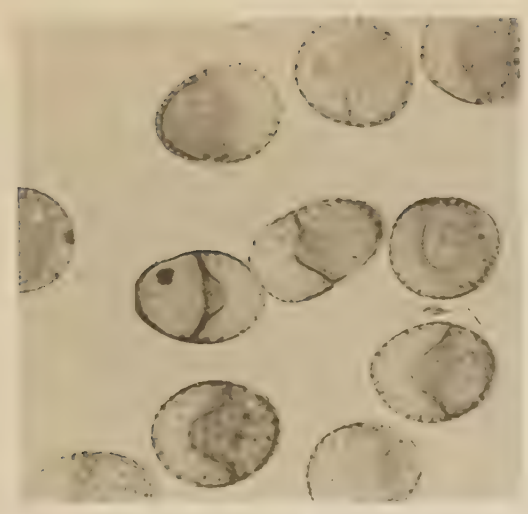
139c. Puccinia Prionosciadii. From Coulterophytum Holwayi, ×500.

139d. Puccinia Prionosciadii. From Prionosciadium Watsoni, ×500.

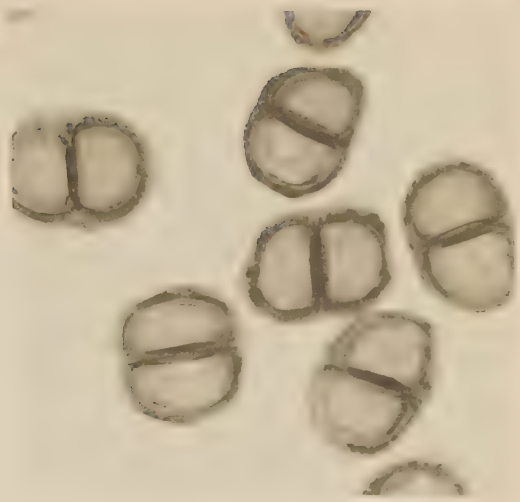
Leptotaenia.

140a. Puccinia asperior. From Californian spec., ×500.

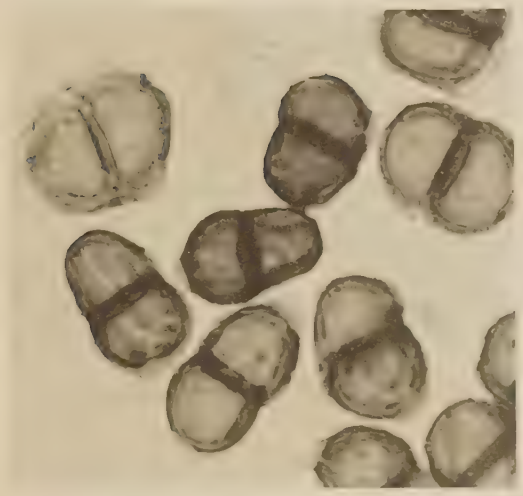
140b. Puccinia asperior. From type of Puccinia Oregonensis, ×500.



139 a

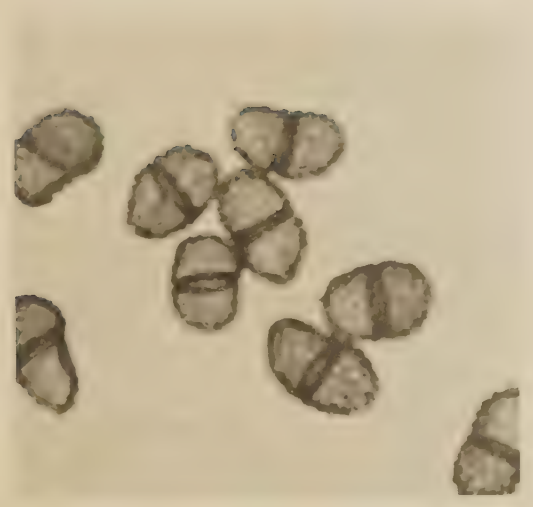


139 b

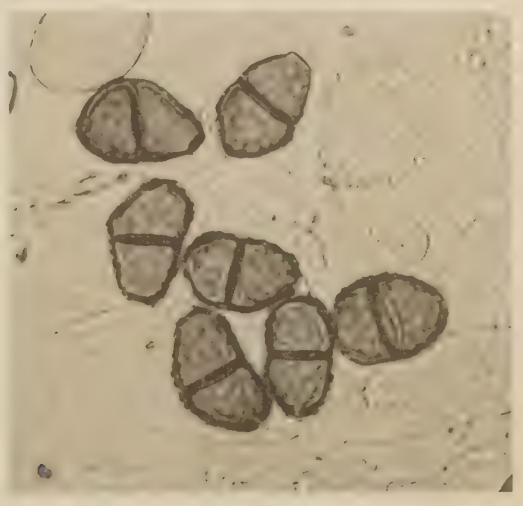


139 c

139 d



140 a



140 b

PLATE 44

Lomatium. Leptotaenia. Musineum.

141a. Pucinia Jonesii. From Lomatium triternatum, ×500.

141b. Puccinia Jonesii. From Leptotaenia multifida, ×500.

141c. Puccinia Jonesii. From Musineum Hookeri, ×500.

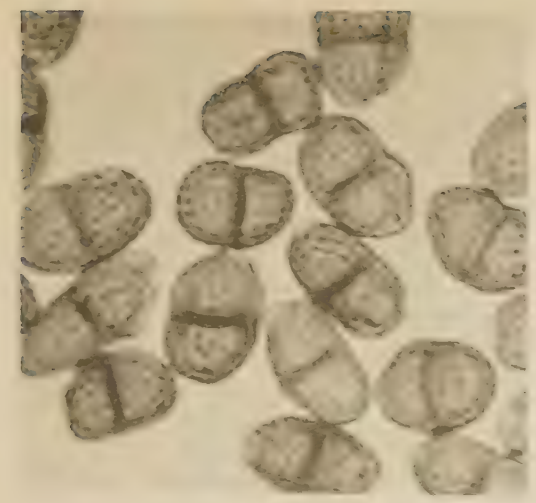
Cynomarathrum.

142a. Puccinia Cynomarathri, Type, ×500.

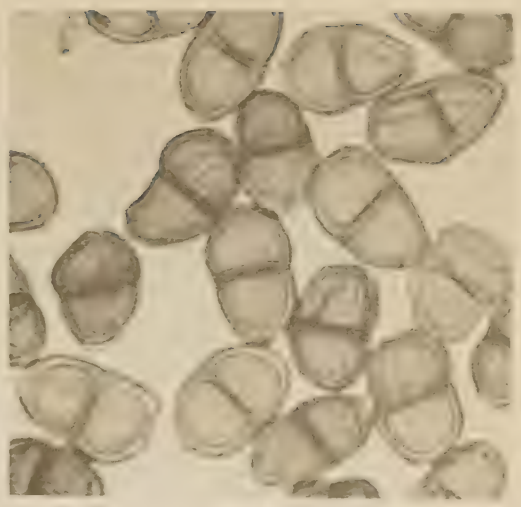
142b. Puccinia Cynomarathri, Type, ×500.

Cornus.

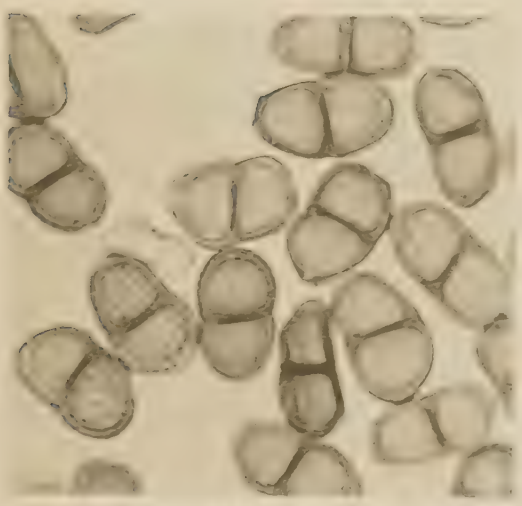
143. Puccinia acuminata. From Washington specimen, ×250.



141 a



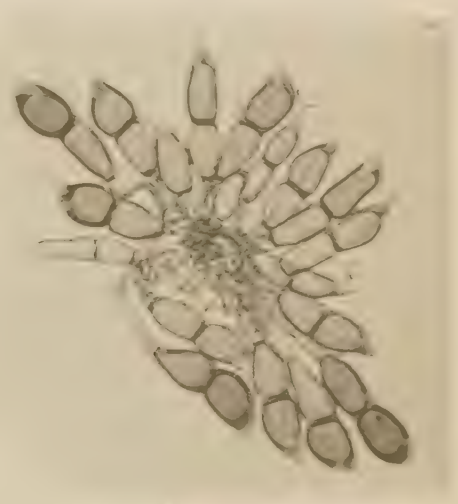
141 b



141 c

142 a

142 b



143

North American Uredineae

E. W. D. Holway

Vol. I. Part V

Genus Puccinia

Primulaceae. Gentianaceae. Asclepiadaceae. Convolvulaceae.
Polemoniaceae. Hydrophyllaceae. Borraginaceae. Verbenaceae.

Minneapolis
University of Minnesota
Issued August 2, 1924

PRIMULACEAE.

DODECATHEON.

144. Puccinia melanconioides Ell. & Everh.

Bull. Calif. Acad. Sci. 1:27. 1884.

Syn: Dicaeoma melanconioides Kuntze. Rev. Gen. 3^3:469. 1898.
Allodus melanconioides Arth. Result. Sci. Congr. Bot. Vienne 345. 1906.

O. Spermogonia amphigenous, in separate groups or scattered among the aecidia, orange-red.

I. Aecidia mostly hypophyllous, in round groups or elongated on the veins and petioles, crowded; aecidiospores globoid to oblong, 20—24×15—18μ, wall 1.5μ thick, finely verrucose.

III. Teleutosori round, rather firm, 9.5—1mm. in diameter, scattered, long, covered by the epidermis, dark brown; teleutospores variable in shape and size, globoid, elliptical or oblong, 30—45×20—30μ, mostly rounded at both ends, sometimes narrowed, angular or irregular, wall uniformly 2.5μ thick, chestnut-brown, smooth, pores prominent, upper at the apex or more or less depressed, lower anywhere except very rarely in the upper ⅓ of the cell, both with low hyaline papillae; pedicel hyaline, up to 50μ long.

On Dodecatheon latifolium (Hook.) Piper; D. Hendersonii A. Gray. Ore., Calif.; D. cruciatum Greene. Calif.; Dodecatheon sp. Idaho.

Photo: No. 144. From D. cruciatum. Calif., ×500.

Type: Calif. "On the upper surface of living leaves of Dodecatheon Meadia. Antioch.," error for Dodecatheon latifolium.

Exsiccati: Ellis, N.A.F. *1059*; Baker, Pacific Slope Fungi *286*; Barth., N.Am. Ured. *155*.

An occasional uredospore has been seen with the teleutospores but uredosori do not occur. The sori appear to be deeper than in the next number, perhaps due to the thicker leaves, and they are not as pulverulent, remaining surrounded by a firm wall. These short-cycle forms are not well known and it is still doubtful whether the following is a distinct species, as it differs only in having uredospores.

145. Puccinia Ortoni Jackson.

Brooklyn Bot. Garden Mem. 1:259. 1918.

O. I. Not seen, although they occur.

II. Uredosori brown, amphigenous, scattered, soon pulverulent; uredospores yellowish-brown, globoid, elliptical or ovate, echinulate with rather short spines, 27—32×22—28μ, pores 3, wall 3μ thick.

III. Teleutosori amphigenous, dark brown, round, punctiform to 1mm. in diameter; at first covered by the epidermis, very soon pulverulent; teleutospores elliptical to oblong, 35—42×20—27μ, mostly rounded at both ends, more or less angular or irregular, wall uniformly 2.5μ thick, chestnut-brown, smooth, pores prominent, upper at the apex, the lower variable, from the septum to the middle of the cell, rarely lower, with conical hyaline papillae; pedicel hyaline, fragile, to 60μ long.

On Dodecatheon alpinum Greene, Calif.; D. Jeffreyi Moore. Calif., Vancouver Island; Dodecatheon sp. Wash.

Photo: No. 145A. From D. Jeffreyi. Vancouver Island, ×500.
No. 145B. From the same, ×500.

Exsiccati: Sydow, Ured. *1774*; Barth., N.Am. Ured. *554*, *1457*.

STEIRONEMA.

146. Puccinia Dayi Clinton.

Rep. N. Y. State Mus. **28**:60. 1876.

Syn: Dicaeoma Dayi Kuntze. Rev. Gen. 3^3:468. 1898.
Dasyspora Dayi Arth. Result. Sci. Congr. Bot. Vienne 346. 1906.

III. Teleutosori hypophyllous, brown, firm, scattered, or crowded in circular or irregular groups, spots red or yellow, depressed opposite the sori, often falling out in old specimens; teleutospores readily germinating in the sorus, light brown, smooth, oblong or oblong-clavate, apex very irregular, from rounded to acute, little thickened or to 10μ, slightly constricted, mostly narrowed to the base, upper pore at the apex, the lower close to the septum, very indistinct, 40—60× 17—20μ; pedicel slightly tinted, to 60μ long.

On Steironema ciliatum (L.) Raf. Iowa, Wis., Ind., Ontario.

Photo: No. 146. From Fungi Columb. *2661*, ×500.
Type: New York. "Leaves of Lysimachia ciliata."
Exsiccati: Barth., N.Am. Ured. *138*; Sydow, Ured. *2413*; Barth., Fungi Columb. *2661*; Ellis, N.A.F. *1453*; Arth. & Holw., Ured. Exsicc. *8*; Seym. & Earle, Econ. Fungi B. *10*; Rabenh.-Wint. Fungi eur. *3206*.

GENTIANACEAE.

GENTIANA.

147. Puccinia Gentianae (Strauss) Lk.

Linn. Sp. Pl. 6^2:73. 1825.

Syn: Uredo Gentianae Strauss Ann. Wetter. Gessell 2^1:102. 1810.
Uredo Gentianae DC. Flora Fr. 6:64. 1815.
Dicaeoma Gentianae Kuntze. Rev. Gen. 3^3:468. 1898.

O. Spermogonia yellow, scattered among the aecidia.

I. Aecidia small, hypophyllous, in round or irregular groups, 3—10mm. in diameter, peridia short, laciniate; aecidiospores globoid, 16—20μ, wall thin, closely and finely verrucose.

II. Uredosori light brown, amphigenous or in some hosts all epiphyllous, long covered by the epidermis, opening by a slit; uredospores globoid to ovate, yellowish-brown, wall 2.5μ thick, echinulate, spines 3—5μ apart, pores 2 or 3, mostly in the upper half of the spore, 20—32×20—25μ.

III. Teleutosori following in the uredosori, soon pulverulent; teleutospores broadly elliptical, rarely oblong, 32—44×22—32μ, rounded at both ends, wall 4μ thick, smooth, dark brown, upper pore at the apex, the lower near the septum, rarely lower, papillae low and broad; pedicel hyaline, fragile, to 50μ long.

On Gentiana Bigelowii Gray. Colo.; G. affinis Griseb. Colo., Wyo., Mont., Utah, N. Dak.; G. Parryi Engelm. Colo., Idaho; G. sceptrum Griseb. Wash.; G. Menziesii Griseb. Calif.; G. Andrewsii Griseb. Wis., Minn., Mich.; G. puberula Mx. Minn.; G. oregana Engelm. Ore.; Gentiana sp. Mexico.

Photo: No. 147A. Uredospores from G. affinis. Colo., ×500.
No. 147B. Teleutospores from G. Bigelowii. Colo., ×500.
No. 147C. Teleutospores from G. affinis. Mont., ×500.

Type: Europe. "a. Gentianae ciliatae."

Exsiccati: Clements, Crypt. Form. Colo. *136, 562*; Barth., N.Am. Ured. *36, 142, 342*; Brenckle, Fungi Dak. *415*; Barth., Fungi Columb. *2451, 4849*; Carleton, Ured. Am. *27*; Ellis, N.A.F. *1037, 2220*; Griffiths, West Am. Fungi *380*.

Distribution: Europe, Siberia, East Indies, N.Am.

All the specimens examined have the regular teleutospores except Nelson's No. *6811*, on Gentiana affinis, from Montana, which has many oblong and irregular 1- and 3-celled teleutospores. A form occurs in Europe, on Gentiana Pneumonathe, with many oblong spores but it has been shown by cultures to be Puccinia Gentianae. Sydow's Uredineen *1587*, issued as Puccinia Gentianae is Uromyces Gentianae Arth. The uredospores of the Uromyces have 2—5 pores, mostly 3—4.

HALENIAE.

148. Puccinia Haleniae Arth. & Holw.

Bull. Geol. & Nat. Hist. Survey Minn. 3:30. 1887.

Syn: Dicaeoma Haleniae Kuntze. Rev. Gen. Pl. 3^3:469. 1898.
Dasyspora Haleniae Arth. Result. Sci. Congr. Bot. Vienne 346. 1906.

O. Not found.

III. Teleutosori firm, black, mostly crowded and confluent in irregular groups on the stem and upper surface of the leaves, surrounded by dark brown paraphyses; teleutospores linear or cuneate-linear, 40—60×8—10μ, smooth, brown, apex darker, slightly thickened, irregularly truncate or rounded; pedicel short, brown, persistent.

On Halenia deflexa Griseb. Minn., Mich. Also reported on Gentiana calycosa Griseb., from Wyoming.

Photo: No. 148. From the type, ×500.

Type: Minn. Vermilion Lake. Holway.

Exsiccati: Barth., N.A. Ured. *145, 448*.

Distribution: Also occurs in Manchuria. Jaczewski, Fungi Rossiae *220*.

SWERTIA.

149. Puccinia Swertiae (Opiz) Wint.

Rabenh. Krypt. Flora 1:205. 1882.

Syn: Aecidium Swertiae Opiz. Seznam Rostlin. :111. 1852.
Aecidium Fraserie Trel. Harriman Alaska Exped. 5:36. 1904.
Dicaeoma Swertiae Kuntze. Rev. Gen. 3^3:470. 1898.
Allodus Swertiae Orton. Mem. N. Y. Bot. Garden 6:195. 1916.

O. Spermogonia orange, few, between the aecidia.

I. Hypophyllous, scattered in round groups 2—4mm. across, opening by a pore when young, finally becoming laciniate; aecidiospores subglobose, finely verrucose, 17—25μ in diameter, wall light golden 1—1.5μ thick.

III. Teleutosori epiphyllous, small, round to oblong, scattered, long covered by the epidermis, pulverulent when old; teleutospores elliptical, 32—42×25—30μ, wall uniformly 2μ thick, smooth, yellowish-brown, rounded at both ends, rarely with the lower cell narrowed, upper pore at or near the apex, the lower from the septum to the middle of the cell, with low, light-colored papillae; pedicel hyaline, fragile, about the length of the spore.

On Swertia perennis L. Alaska; S. scopulina Greene. Colo.

Photo: No. 149. From the Colorado specimen, ×500.

Type: Bohemia. Probably on Swertia perennis L. Opiz merely gives the name in a list of fungi.

Exsiccati: Clements, Crypt. Form. Col. *144.*

Distribution: Europe, N.Am., Turkestan, Siberia.

I have been unable to find uredospores and think the report that they occur is due to an error by Dr. Winter. Fischer, while describing aecidia and uredo, says for both: "Nach Winter." Bubak says: "Winter beschreibt auch die Uredosporen. Es muss hier aber hervorgehoben werden, dass weder Sydow, und Fischer, noch ich, obzwar wir alle reichliches Material zur Verfügung hatten, niemals diese Sporen gesehen haben. Ihre Existenz ist deshalb fraglich." All the specimens of the aecidium seen were without teleutospores but it no doubt belongs here. Bubak says: "Teleutosporenlager blattoberseits, entweder auf schwarzen Aecidienflecken oder zerstreut."

ASCLEPIADACEAE.

ASCLEPIAS.

150. Puccinia concrescens E. & E.

Arthur, Mycologia 7:240. 1915.

Syn: Puccinia compacta Kunze. Bubak, Hedwigia Beibl. 42:30. 1903; Not. Berk. 1855; De Bary. 1858; or Thuem. 1875.

III. Teleutosori hypophyllous, closely crowded in round groups 3—5mm. in diameter, often germinating in the center, firm, brown; teleutospores oblong to elliptical, often irregular, 20—37×12—20μ, mostly rounded at both ends, or the lower cell narrowed from the septum, brown to pale yellowish-brown, smooth, wall of the lower cell 2μ thick, that of the upper cell often a little thicker, apex to 5μ thick, slightly constricted at the septum; pedicel hyaline, persistent, slightly tinted next to the spore, to 75μ long; pores not apparent.

On Asclepias Curassavica L. Porto Rico. Also reported from Cuba and the Bahamas.

Photo: No. 150. Teleutospores from Porto Rico specimen, collected by Holway, ×500.

Type: Porto Rico. On Asclepias Curassavica L. Heller *863*. Aibonito.

Exsiccati: Barth., N.Am. Ured. *1642*.

Distribution: West Indies, Dutch Guiana.

A full history will be found in Mycologia along with the description of the species.

GONOLOBUS. PHILIBERTIA. VINCETOXICUM.

151. Puccinia Gonolobi Rav.

Grev. 3:54. 1874.

Syn: Puccinia Philibertiae E. & E. Bull. Torr. Bot. Club **22**:60. 1895.
Dicaeoma Gonolobi Kuntze. Rev. Gen. 3³:469. 1898.
Dasyspora Gonolobi Arth. Result. Sci. Congr. Bot. Vienne 346. 1906.

III. Sori dark brown to black, amphigenous, or, in many leaf specimens, hypophyllous, minute, crowded into round or irregular groups, often circinate, on the young growth evenly covering the stems and under side of the leaves, occasionally forming "witches'-brooms"; teleutospores elliptical to oblong, 25—37×16—23μ, rarely to 47μ, rounded at both ends, or rarely the lower cell narrowed to the pedicel, wall 2—3μ thick, the apex to 5μ, brown, smooth, the upper pore at the apex, the lower not made out; pedicel hyaline, tinted next the spore, persistent, to 100μ long, rarely inserted laterally.

On Gonolobus suberosus R. Br. S.C.; G. laevis Mx. S.C., Texas; G. bifidis Hemsl. Mexico; G. uniflorus H.B.K. Mexico; G. erianthus Decne. Mexico; Gonolobus sp. ("witches'-brooms") Mexico; Philibertia hirtella Vail. Calif.; P. viridiflora Br. & Rusby. New Mex.; P. linearis A. Gray. Arizona; P. cyanchoides A. Gray. New Mexico; Vincetoxicum palustre (Pursh.) Gray. Florida, Bahamas; V. gonocarpus Walt. Miss.

Photo: No. 151A. From Gonolobus laevis. S.C., ×500.
No. 151B. From Gonolobus sp. Mex.,* ×500.
No. 151C. From Philibertia viridiflora, type of Puccinia Philibertiae, ×500.
No. 151D. From Philibertia cyanchoides. New Mex., ×500.

Type: S.C. On leaves of Gonolobus.

Exsiccati: Ellis, N.A.F. *256*; Barth., Fungi Columb. *2452*; N.Am. Ured. *442*.

Puccinia Oxypetali P. Henn. is no doubt a synonym, although it has variable spores, those in the germinating sori being longer and narrower than in the ungerminated ones.

METASTELMA. PHILIBERTIA. VINCETOXICUM.

152. Puccinia obliqua B. & C.

Jour. Linn. Soc. **10**:356. 1869.

Syn: Puccinia Cynanchi Lagerh. *Bol. Soc. Brot. 7:129. 1889.
Puccinia subcollapsa E. & E. Jour. Mycol. 7:275. 1893.
Dicaeoma Cynanchi Kuntze. Rev. Gen. 3^3:468. 1898.
Dicaeoma obliquum Kuntze. Rev. Gen. 3^3:469. 1898.
Dicaeoma subcollapsum Kuntze. Rev. Gen. 3^3:470. 1898.
Puccinia sphaerospora Syd. & Henn. Ann. Mycol. 1:327. 1903.

III. Spots yellow or brown or wanting; teleutosori hypophyllous or amphigenous, dark brown, firm, circinate in groups up to 8μ in diameter, or surrounding the stems and evenly covering the young leaves; teleutospores globose, subglobose, or elliptical, 25—32x18—22μ, rounded at both ends, wall of uneven thickness, to 3μ thick, the apex to 5μ thick, smooth, light to dark brown, pores not visible; one-celled teleutospores common, globose, 25μ in diameter, apex to 8μ thick; various irregular 3—4 septate and muriform spores occur; pedicel persistent, hyaline, often inserted laterally. Slender, to 90μ long.

On Metastelma Schlechtendalli Decne. Virgin Islands; M. angustifolium Turcz. Mexico; Metastelma sp. Porto Rico, Fla.; Philibertia crassifolia Hemsl. Mexico, Guatemala; Vincetoxicum mexicanum S. Wats. Mexico.

Photo: No. 152A. From the type of Puccinia obliqua, ×500.
No. 152B. From Metastelma Schlechtendalii. St. Croix, probably the type collection of Puccinia sphaerospora, ×500.
No. 152C. From the type specimen of Puccinia subcollapsa. Paraguay, ×500.
No. 152D. From Philibertia crassifolia. Mexico, ×500.
No. 152E. From Metastelma angustifolium. Mexico, ×500.
No. 152F. From Puccinia Cynanchi. Venezuela, collected by Preuss.

Type: Cuba. "On some plant resembling chick-weed" reported by Kew to be probably Metastelma penicillatum.

Distribution: West Indies, So. U.S., Mexico, Central America, S.Am.

The Guatemala specimens on Philibertia crassifolia differ somewhat from the Mexican ones, having many oblong spores, with few globose ones. They have the most unusual assortment of forms, a great variation in size, as well as muriform and many septate spores. The majority of the spores exactly match those of Puccinia Cynoctoni Lev., as represented by Sydow, Uredineen 20A, 21A. Much more material is needed from S.Am. before any final arrangement of all the species can be made, or extensive cultures may be necessary. They are extremely variable and difficult.

MARSDENIA.

153. Puccinia Marsdeniae Diet. & Holw.

Bot. Gaz. **31**:330. 1901.

II. Uredosori amphigenous, scattered, minute, pulverulent, light brown; uredospores globose or subglobose, 28—40μ in diameter, wall 6—8μ thick, yellowish-brown, remotely echinulate with strong spines, pores difficult to count (4—6?).

III. Teleutosori mostly epiphyllous, small, black, scattered, pulverulent; teleutospores dark, reddish-brown, elliptical 42—47×30—37μ, rounded at both ends, wall uniformly 5—6μ thick, densely verrucose, pores not apparent, pedicel hyaline, persistent, up to 75μ long.

On Marsdenia mexicana Decne. Mexico, Guatemala.

Photo: No. 153A. Uredospores from the type, ×500.
No. 153B. Teleutospores from the type, ×500.

Type: Mexico. On Marsdenia mexicana. Cuernavaca, Sept. 29, 1899. Holway No. *3529*.

Exsiccati: Barth., N.A. Ured. *352*.

The host plant was seen in one locality only in both Mexico and Guatemala.

CONVOLVULACEAE.

CONVOLVULUS. IPOMOEA.

154. Puccinia Convolvuli (Pers.) Cast.

*Obs. 1:16. 1842.

Syn: Uredo Betae Convolvuli Pers. Syn. Method. :221. 1801.
Aecidium dubium Clinton. 1873 Report N.Y. State Mus. 27:104. 1875.
Aecidium Calystegiae Cast. Desm. Ann. Sc. Nat. 8:14. 1847.

O. Not seen.

I. Aecidia in round groups, often concentric, cups small, peridia reflexed, laciniate, fragile; aecidiospores oblong, angular or globoid, wall 1.5μ thick, closely and minutely verrucose, 18—27x13—20μ.

II. Uredosori mostly hypophyllous, brown, round, scattered, early naked; uredospores globoid to ovate, light brown, echinulate, spines short, wall 2μ thick, 23—30x23—25μ, pores 3, equatorial.

III. Teleutosori round, mostly hypophyllous, black, scattered or slightly confluent, often covering the leaf, long covered by the grey epidermis; teleutospores oblong or clavate, rarely elliptical, 40—62x23—30μ, apex mostly rounded, in some specimens truncate or angular, up to 8μ thick, wall 2.5μ thick, the lower cell sometimes smaller and narrowed, chestnut-brown, smooth, upper pore at apex, lower near the pedicel, which is persistent, brown, short.

On Convolvulus sepium L. Kan., New Jersey, Ill., Mass., Iowa, Mo., Ind., West Va.; C. luteolus A. Gray. Calif.; C. subacaulis Buch. Ham. Calif.; C. atriplicifolius Poir. Ore.; C. spithameus L. Minn.; C. repens L. Nebr. Calif.; C. arvensis L. Mass.; C. californicus Choisy. Calif.; Ipomoea pandurata (L.) Meyer. Delaware.

Photo: No. 154A. Uredospores from Barth., Fungi Columb. *2354*, ×500.
No. 154B. Teleutospores from Seymour & Earle, Econ. Fungi *332*A, ×500.

Type: Uredo. Europe. "In fol. Convolv. arvensis."

Distribution: Europe, Africa, Japan, N.Am.

Exsiccati: Carleton, Ured. Am. *11*; Ellis & Everh., N.A.F. *1857*, *2251*, *3346*; Ellis, N.A.F. *255*, *1011*; Barth., Fungi Columb. *1958*, *2053*, *2354*, *5056*; Barth., N.A. Ured. *427*, *428*, *936*, *937*, *1037*, *1234*; Seym. & Earle, Econ. Fungi. *331*, *332*, *492*; Sydow, Ured. *1171*.

Arthur sowed teleutospores on Convolvulus sepium and they were followed by a rich development of spermogonia and aecidia. Fischer says of the uredospores: "Aequatoriale Zone oft ganz glatt," but I have not found them so, nor has Grove in England.

CRESSA.

155. Puccinia Cressae (DC) Lagerh.

*Bol. Soc. Brot. :131. 1889.

Syn: Aecidium Cressae DC. Flora Fr. 6:89. 1815.
Caeoma Cressatum Lk. Linne Sp. Pl. 6^2:49. 1825.
Puccinia cretica Holw. Erythea 5:31. 1897.
Dicaeoma Cressae Kuntze. Rev. Gen. 3^3:468. 1898.

I. Aecidia hypophyllous, usually covering the leaves, varying in different collections from short to cylindrical, 9.5—1mm. long, margin lacerate, not reflexed; aecidiospores globoid to angular, wall 1.5μ thick, minutely and closely verrucose, 18—25μ in diameter.

II. Uredosori cinnamon-brown, hypophyllous, rarely amphigenous, scattered, pulverulent; uredospores brown, echinulate, globoid, ovate or elliptical, wall 2μ thick, pores 2, with prominent hyaline papillae, 20—32x20—26μ.

III. Teleutosori dark brown, mostly hypophyllous, scattered, 1mm. in diameter, pulverulent; teleutospores smooth, clear yellowish-brown, broadly elliptical to oblong, 32—40x20—28μ, rounded at both ends or sometimes irregular and angular, or the lower cell narrowed to the pedicel, wall 1.5—2μ thick, upper pore at the apex, the lower about the middle of the cell, slightly constricted at the septum, pedicel fragile, hyaline, short.

On Cressa cretica L. Calif.; C. aphylla Heller. Texas; C. Truxillensis H.B.K. Utah, Texas, Calif.; C. depressa Good. Arizona.

Photo: No. 155A. Uredospores from Lagerheims type on Cressa villosa, ×500.
No. 155B. Teleutospores from the same, ×500.
No. 155C. Teleutospores from the type of Puccinia cretica, ×500.

Type: Aecidium. France. Leaves of Cressa cretica.
Uredo and teleutospores. Portugal. On leaves of Cressa villosa Hoffm.

Exsiccati: Barth., N.Am. Ured. *1644*, *1645*; Garrett, Fungi Utah *91*, *158*; Baker, Pac. Slope Fungi *1568*.

Distribution: Europe, Africa, N.Am.

Uredospores rarely occur in the collections examined. Before publishing Puccinia cretica I sent a specimen to Dr. Lagerheim to compare with his and he wrote me that they were not the same, an opinion I afterwards ascertained that he based upon the lack of uredospores in my specimen. When others were sent him with uredospores he said they were the same, and sent a slide of his from which the photographs were made.

DICHONDRA.

156. Puccinia Dichondrae Mont.

Gay, Flora Chilena **8**:46. 1852.

Syn: Puccinia Dichondrae Berk. Jour. Linn. Soc. **13**:173. 1873.
Puccinia Berkleyana De Toni. Sacc. Syll. 7:717. 1888.
Aecidium Dichondrae Har. Bull. Soc. Mycol. de Fr. 7:149. 1891.
Aecidium Dichondrae Neg. *An. Univer. Santiago :49-52. 1896.
Puccinia munita Ludw. Zeitschrift f. Pflkrh. **2**:133. 1892.
Dicaeoma Dichondrae Kuntze. Rev. Gen. 3^3:468. 1898.

I. Aecidia mostly hypophyllous, often covering the leaf, minute, short: peridia whitish, finely lacerate, reflexed; aecidiospores globoid to angular, nearly hyaline, minutely punctate, wall very thin, 15—20μ in diameter.

III. Teleutosori chestnut-brown, hypophyllous, often covering the leaf, rarely few and scattered, minute, pulvinate, rather firm; teleutospores variable in size, oblong, elliptical or oblong-clavate, 28—45×15—20μ, smooth, wall from 1μ thick in the lower cell to 2μ in the upper, light brown, apex rounded and little thickened or with a light colored point 3—8μ long, slightly constricted at the septum, base rounded or narrowed, pores not apparent; pedicle hyaline, persistent, to 50μ long.

On Dichondra repens Forst. Calif., Texas, Bermuda; D. sericea Sw. Guatemala.

Photo: No. 156. Teleutospores from Californian specimen, ×500.

Type: Chile. "Esta especie se halla en las hojas del Dichondra sericea."

Distribution: Africa, S.Am., Australia.

No American specimens of the aecidium have been seen.

The description of the aecidium is from a specimen collected in Chile.

While no teleutospores occur on the leaves the collector states April and May for the date and May for the teleutospores. I searched carefully for aecidia in Guatemala without success, and McAlpine could not find any in Australia. He says:

> The teleutospores are frequently 3 to 4 celled, and there is a great variety in the arrangement of the septa. The spore may be divided vertically as in Diorchidium, or it may have a vertical or oblique septum in its upper or lower cell. The septa may even be arranged muriformly. There may be a lateral hyaline apiculus in the lower as well as in the upper cell, and the pedicel may stand out at right angles to the lower cell. There is thus every gradation from the unicellular spore and the bicellular, in which the upper cell is more or less atrophied, up to the multicellular, which is vertically, obliquely or muriformly divided.
>
> Aecidia have been found on this plant and are regarded as belonging to this species, but although numerous specimens have been examined from various localities no trace of aecidiospores have been found here.

EVOLVULUS.

157. Puccinia Lithospermi Ellis & Kellerm.

Jour. Mycol. **1**:2. 1885.

Syn: Dicaeoma Lithospermi Kuntze. Rev. Gen. 3^3:469. 1898.

II. Uredosori cinnamon-brown, small, scattered, pulverulent; uredospores dark yellowish-brown, elliptical to globoid, 20—25×17—25μ, echinulate, spines 2.5μ apart, wall 2.5μ thick, often with a short hyaline pedicel attached, pores 2, equatorial.

III. Teleutosori black, amphigenous, scattered, pulverulent, 0.3—0.5mm. in diameter; teleutospores oblong to cuneate-clavate, 40—62×18—25μ, wall 1μ thick in the lower cell, becoming thicker above, smooth, dark brown, apex rounded and little thickened or with a light colored point 8—13μ long or obliquely truncate; pores not apparent; pedicel firm, tinted, to the length of the spore.

On Evolvulus pilosus Nutt. Nebr., Colo., Kan.

Photo: No. 157. Teleutospores from Fungi Columb. *2151*, ×500.

Type: Kansas. "On Lithospermum canescens, Manhattan." Error for Evolvulus pilosus.

Exsiccati: Sydow, Ured. *2123*; Barth., Fungi Columb. *2151*, *2962*; Barth., N.Am. Ured. *45*; Clements, Crypt. Form. Colo. *568*.

IPOMOEA.

158. Puccinia crassipes B. & C.

Grev. 3:54. 1874.

Syn: Puccinia opulenta Speg. Anal. Soc. Ci. Argent. 9:170. 1880.
Aecidium Ipomoeae Speg. l.c. :173. 1880.
Puccinia Ipomoeae Cke. Lagerh. Tromso Mus. Aarshefter 17:61. 1895.
Dicaeoma crassipes Kuntze. Rev. Gen. 3³:468. 1898.
Dicaeoma opulentum Kuntze. Rev. Gen. 3³:469. 1898.
Dicaeoma Ipomoeae Kuntze. Rev. Gen. 3³:469. 1898.
Allodus crassipes Arth. Result. Sci. Congr. Bot. Vienne 345. 1906.
Allodus opulenta Orton. Mem. N.Y. Bot. Garden 6:195. 1916.

I. Aecidia mostly hypophyllous, scattered or clustered in small groups, often thickly covering the leaf, peridia short, fragile, laciniate, not much reflexed; aecidiospores subglobose, ovate, elliptical or angular, 20—30×18—25μ, wall 1.5μ—2.5μ, closely verrucose.

III. Teleutosori amphigenous, scattered, opposite the aecidia or following in and around them, black, ruptured epidermis prominent; teleutospores elliptical, rarely oblong, 50—62×25—37μ, both cells rounded, or in the longer spores more or less narrowed from the septum, slightly constricted, wall 5μ thick, dark reddish-brown, coarsely verrucose, apex with a broad, low, yellowish umbo or sometimes pointed up to 12μ thick, upper pore at apex, the lower close to the septum; pedicel persistent, hyaline, tinted next the spore, to 100μ long.

On Ipomoea trichocarpa Ell. (This is the type collection, not seen.) S.C.; I. tiliacea (Willd.) Choisy. Guatemala; I. glabriuscula House. Guatemala; I. purga Hayne. Costa Rica, Mexico; Ipomoea sp. Cuba, Mexico, Costa Rica, Guatemala, Fla.; I. Steudelii Millsp. St. Thomas, West Indies; I. triloba L. St. Croix, West Indies, Tex.

Photo: No. 158. On I. sp. Fla., ×500.

Type: S.C. "On leaves of Ipomoea trichocarpa."

Distribution: So. U.S., West Indies, Mexico, Central and S.Am.

Exsiccati: Barth., Fungi Columb. *2456*, *4853*.

The aecidia continue to form for some time and the teleutospores are late in appearing, although they come with the aecidia. Orton considers Puccinia opulenta Speg. a good species and says that it is easily distinguished by the thick walls of the aecidiospores, 3—3.5μ thick. Specimens of P. opulenta from Spegazzini have the walls from 1.5—2.5μ, mostly 2.5μ, perhaps the thinner

ones are not fully mature, although they were full size. I think that the walls are likely to be thicker in old specimens. The only one with walls 3—3.5μ thick is the St. Thomas collection.

The St. Croix specimen has walls 1—1.5μ; Cuban, 1.5—2μ; Florida, 2μ; Central American and two other South American collections, 2.5μ thick. Teleutosporic material is limited but there appears to be no difference. Sydow, with ample material, says they are all the same. As different collections of Puccinia nocticolor vary as much as 6μ in the apical thickening of the aecidiospores, with all other characters the same, it seems unwise to make two species here. More material, especially from South America, is needed.

159. Puccinia nocticolor Holway.

Ann. Mycol. **2**:391. 1904.

Syn: Allodus nocticolor Orton. Mem. N.Y. Bot. Garden **6**:197. 1916.

I. Aecidia mostly hypophyllous, in round groups or elongated along the veins, white, cylindrical, 1—2mm. in length, finally irregularly lacerate, easily breaking away and leaving a cup in the leaf; aecidiospores globoid or angular, minutely and closely verrucose, wall irregularly thickened, 2—5μ thick, the apex to 8μ thick, in one specimen to 12μ thick.

III. Teleutosori black, at first minute and surrounded by the epidermis, soon pulverulent, more often hypophyllous among the aecidia, sometimes amphigenous and confluent in large groups; teleutospores elliptical to oblong, mostly oblong, 50—80×32—40μ, wall 3—4μ thick, dark brown, almost opaque, slightly constricted, verrucose, with low tubercles, base mostly rounded, apex usually prolonged into a light colored point to 10—15μ; pedicel hyaline, tinted next the spore, to 160μ long.

On Ipomoea intrapilosa Rose. Mexico; I. fistulosa Mart. Guatemala, Mexico.

Photo: No. 159. From type, ×500.

Type: Mexico. On Ipomoea intrapilosa Rose. Cuernavaca, Holway, No. *3549*.

Exsiccati: Barth., N.Am. Ured. *1461*.

The apical thickening of the aecidiospores in the Guatemala collection is very much greater than in any others. The other characters are the same.

160. Puccinia megalospora (Orton) Arth. & Johnst.

Mem. Torr. Bot. Club **17**:152. 1918.

Syn: Allodus megalospora Orton. Mem. N. Y. Bot. Garden **6**:198. 1916.

I. Aecidia mostly hypophyllous, scattered or in small groups, peridia laciniate, fragile; aecidiospores subglobose, 25—35×25—27μ, wall 1—2μ thick, closely verrucose.

III. Teleutosori amphigenous, scattered or in small groups among and opposite the aecidia, at first minute and covered by the epidermis, opening by a pore, black, finally confluent along the veins and pulverulent; teleutospores elliptical to oblong, 50—75×28—35μ, both cells rounded or one or both narrowed from the septum, wall 3—5μ thick, deep brown, coarsely verrucose, apex either rounded and not thickened or mostly with a lighter colored broad umbo, making the apex to 12μ thick, upper pore at the apex, the lower not apparent; pedicel persistent, hyaline, tinted next the spore, to 100μ long, 10—12μ wide.

On Ipomoea arborescens (H. & B.) Don. Mexico; I. intrapilosa Rose. Mexico; I. murucoides R. & S. Mexico.

Type: Mexico. On Ipomoea murucoides, Oaxaca.

Exsiccati: Barth., N.Am. Ured. *429*, Fungi Columb. *5067*; Sydow, Ured. *2036*.

Photo: No. 160. From type, ×500.

The teleutospores are very much like those of Puccinia nocticolor, but the aecidiospores are quite distinct, being quite regularly globoid, with always thin walls. It is best to heat the spores for examination in 50 per cent lactic acid, as in water the contents remain shrunken and one might think the walls thicker than they really are.

Orton reports this from the West Indies.

161. Puccinia rubicunda Holway.

Ann. Mycol. 2:392. 1904.

I. Aecidia amphigenous, scattered or in small groups on yellow or brown spots, opening by a pore; aecidiospores globose or angular, 25—35×20—25μ, wall 2.5μ thick, evenly covered by irregular flat tubercles.

III. Teleutosori epiphyllous, black, minute. The ruptured epidermis surrounding them like a tube, tardily pulverulent, often circinate around one or more aecidia; teleutospores elliptical, 45—50×24—35μ, rounded at both ends, closely covered with irregular flat tubercles, wall 2.5μ thick, pores 2 in each cell, at the septum, each with a low hyaline papilla, not always visible in mature spores; pedicel hyaline, persistent, to 70μ long, slightly tinted next the spore.

On Ipomoea fistulosa Mart. Near Vera Cruz, Mexico. Holway, No. *3084*, Oct. 5, 1898.

Photo: No. 161. From type, ×250.

Known only from the type collection. A very distinct species, peculiar for the number and position of the pores.

162. Puccinia superflua Holw.

Ann. Mycol. 2:392. 1904.

Syn: Allodus superflua Orton. Mem. N. Y. Bot. Garden 6:198. 1916.

I. Aecidia hypophyllous, scattered, extremely fragile, only slightly lacerate; aecidiospores ovate or subglobose, 23—30×18—23μ with large flat tubercles.

III. Teleutosori mostly epiphyllous, black, punctiform, scattered, ruptured epidermis prominent; teleutospores elliptical, 43—68×27—36μ, rounded at both ends, wall 3—4μ thick, opaque, bright mahogany-red, verrucose, with very low tubercles, pores not visible, apex with an abrupt lighter colored conical point, 10—12μ long; pedicel hyaline, tinted next the spore, to 90μ long, 10—12μ wide.

On Ipomoea arborescens (H. & B.) Don.

Photo: No. 162. From type, ×250.

Type: Mexico. On Ipomoea murucoides, error for I. arborescens, Iguala, State of Guerreo, Holway, Oct. 4, 1900.

Known only from the type collection.

163. Puccinia insignis Holway.

Ann. Mycol. 2:392. 1904.

Syn: Allodus insignis Orton. Mem. N. Y. Bot. Garden 6:197. 1916.

I. Aecidia hypophyllous, scattered, slender, tubular, 1mm. long, not reflexed; aeciospores globoid, wall 2.5μ thick, thickly covered with easily deciduous low flat tubercles, 23—25μ in diameter.

III. Teleutosori epiphyllous, minute, surrounded by the ruptured epidermis, black; teleutospores dark brown, elliptical to oblong, 55—75×30—35μ, wall 2.5μ thick, closely and minutely striate-tuberculate, rounded at the base or narrowed from the septum, the apex rounded and prolonged into a conical point up to 16μ long, pores not apparent; pedicel hyaline, tinted next the spore, 12μ wide, to 80μ long, fragile.

On Ipomoea Wolcottiana Rose. Mexico.

Photo: No. 163. From type, ×500.

Type: Mexico. On Ipomoea sp. Cuernavaca, Sept. 25, 1896. Holway. (Since determined to be on Ipomoea Wolcottiana Rose.)

Known only from the type locality, where another collection was made Sept. 29, 1899.

POLEMONIACEAE.

GILIA.

164. Puccinia giliicola P. Henn.

Hedw. 37:270. 1898.

Syn: Allodus Giliae Orton. In part. Mem. N. Y. Bot. Garden 6:199. 1916.

III. Teleutosori amphigenous, minute, black, very soon dusty, never covered by the epidermis, scattered; teleutospores, oblong, rarely elliptical, 32—45×17—22μ, constricted at the septum, rarely with both cells rounded, usually both narrowed from the septum, sometimes angular, wall 2μ thick, deep reddish-brown apex mostly not thickened, occasionally to 5μ thick, smooth, pore seldom at the apex but not below the middle of the cell, lower pore from the middle of the cell to the pedicel, with small hyaline papillae; pedicel hyaline, generally short, rarely to 40μ long, 2—5μ wide, delicate and very fragile.

On Gilia californica (Hook. & Arn.) Benth. Mendoze Co. Calif. Purpus.

Photo: No. 164. From Rabenh.-Paz., Fungi eur. *4221*, ×500.

Type: Known only from the one collection.

Exsiccati: Sydow, Ured. *1212*; Rabenh.-Paz., Fungi eur. *4221*.

Hennings lists this under the name of Puccinia Giliae and describes uredospores which do not exist. He calls attention to the way in which it differs and then says: "Vielleicht ist der vorliegende Pilz besser als eigene Art. P. giliicola aufzustellen."

Orton considers this as one of the forms of Puccinia plumbaria, but the color is quite different, a peculiar red very difficult to photograph; the spores are narrower and the position of the upper pore is different. The sori soon become dusty which is not true of any other collection.

COLLOMIA. GILIA.

165. Puccinia Giliae Harkness.

Bull. Calif. Acad. Sci. 1:—(14). 1884.

II. Uredosori epiphyllous, round, pulvinate, firm, scattered, brown, surrounding epidermis prominent; uredospores ovate or globoid, 27—35×23—28μ, wall 3μ thick, yellowish-brown, echinulate, spines short; pores 2, equatorial.

III. Teleutosori amphigenous, black, rather firm, round to oblong, pulvinate, more or less confluent, at first covered by the epidermis; teleutospores oblong-elliptical, 35—50×20—25μ, rounded at both ends or the lower cell narrowed, wall of the lower cell 2μ thick, gradually becoming thicker in the upper cell, slightly constricted at the septum, smooth, apex mostly 5μ thick, sometimes pointed and to 10μ thick, pores not apparent; pedicel hyaline, persistent, to 100μ long.

On Gilia divaricata Nutt. Calif.; G. pungens (Torr.) Benth. Wyo.; G. capitata Dougl. Calif.; G. pinnatifida Nutt. Colo.; G. atractyloides (Benth.) H. & A. Calif.; G. gilioides (Benth.) Greene. Calif.; G. liniflora Benth. subsp. pharnaceoides (Benth.) Brand. Calif.; Collomia grandiflora Dougl. Wash., Calif.; Navarretia squarrosa (Eschsch.) Hook & Arn. Ore.; Navarretia intertexta (Benth.) Ore.

Photo: No. 165. On G. atractyloides Calif., ×500.

Type: Calif. "On leaves and subtending bracts of Gilia ciliata." Not seen.

Exsiccati: Ellis, N.A.F. *1058*; Barth., N.A. Ured. 37:*441*, *1650*; Fungi Columb. *2960*.

No other stages of this have been seen.

PHLOX.

166. Puccinia Douglasii Ell. & Everh.

Proc. Acad. Phila. 1893:152. 1893.

Syn: Dicaeoma Douglasii Kuntze. Rev. Gen. 3^3:468. 1898.
Puccinia Richardsonii Syd. Monogr. Ured. 1:317. 1902.
Allodus Douglasii Orton. Mem. N.Y. Bot. Garden 6:198. 1916.

I. Aecidia epiphyllous, thickly covering the leaves, apparently from a perennial mycelium, as plants attacked are more slender, peridia split into few divisions, not much reflexed; aecidiospores globoid, more or less angular, 17—20×15—18μ, wall 1.5—2μ thick, finely verrucose.

III. Teleutosori mostly hypophyllous, surrounded by the ruptured epidermis, firm, small, pulvinate, black, in 2 rows or scattered; teleutospores oblong or clavate, 37—54×16—25μ, mature spores deep brown, constricted at the septum, wall of the lower cell 2μ thick, somewhat thicker in the upper cell, smooth, apex rounded or pointed, to 17μ thick, lower cell mostly narrowed to the pedicel, pores not apparent; pedicel hyaline, persistent, to 100μ long.

On Phlox Douglasii Hook. Utah, Ore.; P. Douglasii Hook. var diffusa (Benth.) Gray. Wash.; P. subulata L. New Jersey; P. procumbens Lehm. Penn.; P. multiflora depressa E. Nelson. Utah; P. canescens Torr. & Gray. Utah; P. albomarginata Jones. Mont.; P. diapensioides Rydb. Mont.

Photo: No. 166A. From Phlox Douglasii, type collection, ×500.
No. 166B. From Phlox procumbens, Penn., ×500.
No. 166C. From Phlox albomarginata Jones, type collection of Puccinia Richardsonii Syd., ×500.

Type: Utah. On leaves of Phlox Douglasii, Detroit.

Exsiccati: Ellis & Everh., Fungi Columb. *1466*; Ellis & Everh., N.A.F., *2991*; Garrett, Fungi Utah *28*; Barth., N.A. Ured. *54*.

Uredospores indistinguishable from those of Puccinia Giliae, occur in most of the collections, but no uredosori have been found and are believed not to occur.

It has been impossible to determine the hosts from the small specimens in the packets of fungi.

COLLOMIA. GILIA.

167. Puccinia plumbaria Peck.

Bot. Gaz. **6**:228. 1881.

Syn: Puccinia Wilcoxianum Thuem. Myc. univ. *2032*. 1881.
Puccinia Purpusii P. Henn. Hedw. **37**:270. 1898.
Dicaeoma plumbarium Kuntze. Rev. Gen. **3**^{3}:470. 1898.
Allodus plumbaria Arthur. Result. Sci. Congr. Bot. Vienne 345. 1906.
Allodus Giliae (Peck) Orton. In part. Mem. N.Y. Bot. Garden **6**:199. 1916.

I. Aecidia hypophyllous, closely covering the leaf, peridia reflexed and cut into many sections; aecidiospores angular, globoid or oblong, wall about 1μ thick, in old specimens sometimes irregularly thickened to 2.5μ, 17—25×15—18μ, finely and closely verrucose.

III. Teleutosori amphigenous, sometimes occurring with the aecidia but more often later and without them, round to oblong, thickly covering the leaves, sometimes confluent and surrounding the stems, black, long covered by the epidermis, finally pulverulent; teleutospores oblong, rarely elliptical, more or less angular, 32—40×20—24μ, wall 2—3μ thick, rarely 4μ thick, brown, closely and evenly verrucose, apex to 6μ thick, usually rounded at both ends, upper pore at or near the apex, the lower close to the septum, pedicel hyaline, fragile, abruptly contracted near the spore where it usually breaks off, to 65μ long, 3μ wide.

On Gilia gracilis var. micrantha (Kellogg) Brand. Utah; G. ciliata Benth. var. neglecta (Greene) Brand. Calif.; G. gracilis (Dougl.) Hook. Utah, Wash., Idaho, Mont.; G. ciliata Benth. Calif.; Collomia tinctoria Kellogg. Ore.

Photo: No. 167A. On Gilia gracilis, type collection of Puccinia plumbaria, ×500.
No. 167B. On Gilia gracilis, type of Puccinia Purpusii, ×500.
No. 167C. On Gilia gracilis, Calif., ×500.

Type: Utah. Living leaves and stems of Collomia gracilis and Phlox longifolia. Jones.

Exsiccati: Barth., N.A. Ured. *254*, *360*; Sydow, Ured. *1527*, *1938*; Ell. & Everh., Fungi Columb. *1970*; Garrett, Fungi Utah. *3*; Thuem. Myc. univ. *2032*.

The part of the type specimen of Puccinia Purpusii in the herbarium consists of two opposite leaves covered with aecidia and the host is no doubt Gilia gracilis. Very few teleutospores were found on it. This species is distinguished from the following by the position of the pores

and the thickened apex of the teleutospores. There are two specimens of Aecidium Wilcoxianum Thuem. Myc. univ. *2226*, in the herbarium. One of them is Puccinia Douglasii E. & E., aecidium, on Phlox Douglasii; the other has the teleutospores of this species on the same host and also some detached leaves of perhaps Phlox longifolia with the aecidium of Puccinia fragilis.

Sydow, Ured. 35A. from Chile, on Collomia sp. agrees exactly with Californian specimens of Puccinia plumbaria.

GILIA. PHLOX.

168. Puccinia fragilis Tracy & Hall.

Jour. Mycol. **4**:20. 1888.

Syn: Aecidium Giliae Peck. Bot. Gaz. **4**:230. 1879.
Puccinia arabicola E. & E. Jour. Mycol. **6**:119. 1890.
Aecidium Phlogis E. & E. Bull. Torr. Bot. Club **24**:284. 1897.
Dicaeoma arabicola Kuntze. Rev. Gen. 3^3:467. 1898.
Dicaeoma fragile Kuntze. Rev. Gen. 3^3:468. 1898.
Allodus Giliae (Peck) Orton. In part. Mem. N. Y. Bot. Garden **6**:199. 1916.

I. Aecidium as in Puccinia plumbaria Peck.

III. Teleutosori amphigenous or hypophyllous, round to elliptical, long covered by the epidermis, finally pulverulent, brown; teleutospores elliptical to oblong, 32—48×18—24μ, both cells rounded or one or both narrowed from the septum, wall 1—2.5μ thick, brown, from slightly to strongly verrucose, pore of the upper cell near the apex, that of the lower from the middle to the pedicel, which is hyaline and fragile.

On Phlox longifolia Nutt. Colo., Idaho, Nev., Utah; P. pilosa L. Texas; P. Stanburyi (Torr.) Heller. Nev.; P. divaricata L. Iowa; Phlox Douglasii Hook. Calif.; P. speciosa Pursh. Ore.; P. Hoodii Richards. Mont.; Gilia Nuttalii A. Gray. Utah; Phlox sp. New Mex.

Photo: No. 168A. From the type of Puccinia fragilis, ×500.
No. 168B. From Baker, Earle & Tracy, Plants of So. Colo. 423A, ×500.
No. 168C. From the type of Puccinia arabicola, ×500.
No. 168D. From Phlox divaricata, Decorah, Iowa, ×500.

Type: Nevada. On leaves of Arenaria pungens, error for Phlox.

Exsiccati: Barth., N.Am. Ured. *162*, *255*; Ellis, N.A.F. *1044*, *1432*, *3582*; Baker, Earle & Tracy, Plants of So. Colo. *423A*; Vestergren Micromycetes *977*, *1034*; Garrett, Fungi Utah, *1*, *2*; Sydow, Ured. *1936*, *1937*, *1939*; Ellis & Everh., Fungi Columb. *1861*; Rabenh.-Wint., Fungi eur. *3519*.

The host of Puccinia arabicola was said to be Arabis and that of Puccinia fragilis, Arenaria pungens, but both are Phlox. The specimens on Phlox longifolia and P. speciosa have mostly elliptical teleutospores with thicker walls. In the Iowa collection the sori are amphigenous on large yellow spots.

POLEMONIUM.

169. Puccinia Polemonii Diet. & Holw.

Bot. Gaz. **18**:255. 1893.

Syn: Puccinia Polemonii Störmer. Bot. Not. :214. 1896.
Dicaeoma Polemonii Kuntze. Rev. Gen. 3^3:470. 1898.

III. Teleutosori amphigenous, rounded, scattered, or clustered in groups to 2mm. in diameter; teleutospores of two kinds, the most numerous ones germinating at

once, hyaline, oblong, constricted at the septum, 35—45×12—15μ, both cells narrowed from the septum, wall 1.5μ thick, smooth, apex rounded or pointed, 5—8μ thick; pedicel persistent, hyaline, to 75μ long. Intermixed and especially in the outer sori are yellowish-brown teleutospores, rather wider, with fragile pedicels, apparently germinating after a period of rest; pores inconspicuous, the upper at the apex, the lower near the septum, showing only in the brown spores.

On Polemonium occidentale Greene (P. caeruleum L., as distributed). Kootenai Co., Idaho, Sandberg.

Photo: No. 169. From the type, ×500.

Distribution: Idaho, Norway, Finland.

The photograph was made from the hyaline spores stained with fuchsin, and mounted in lactic acid.

LOESELIA.

170. Puccinia fumosa Holw.

Ann. Mycol. 3:23. 1905.

I. Aecidia hypophyllous, on round or irregular yellow spots, closely clustered or scattered, margin reflexed and finely divided; aecidiospores subglobose to oblong, somewhat angular, 16—25×13—18μ, wall 1μ thick, closely verrucose.

II. Uredosori amphigenous, opposite and among the aecidia and on separate leaves, minute, long covered by the epidermis, brown; uredospores ovate, subglobose or oblong, wall 1.5—2μ thick, echinulate, mostly 18—30×17—24μ, pores 2 equatorial, with a flat hyaline papilla.

III. Teleutosori hypophyllous, scattered in irregular groups or circinate around a central sorus, long covered by the epidermis, black, finally pulverulent; teleutospores elliptical, oblong, or clavate, 40—50×18—25μ, upper cell rounded, lower narrowed from the septum, apex rounded, pointed or truncate, 5—10μ thick, wall of the lower cell 1.5μ thick, that of the upper 2.5μ, deep brown, smooth; pedicel slightly tinted, stout, 10μ wide next the spore, to 40μ long.

On Loeselia ciliata L. Mexico, Guatemala; L. mexicana (Lam.) Brand. Mexico; L. glandulosa (Cav.) G. Don. Mexico, Guatemala.

Photo: No. 170. From the type, ×500.

Type: Mexico. On Loeselia glandulosa. Iguala, State of Guerreo.

Exsiccati: Barth., N.Am. Ured. *1342*; Sydow, Ured. *1977*.

HYDROPHYLLACEAE.

HYDROPHYLLUM.

171. Puccinia Hydrophylli Peck & Clinton.

30th Rep. N.Y. State Mus. 1876:54. 1878.

Syn: Dicaeoma Hydrophylli Kuntze. Rev. Gen. 3^3:469. 1898.

III. Teleutosori amphigenous, on yellow spots, soon naked and pulverulent, dark brown, usually confluent in large irregular groups; teleutospores globoid, elliptical or oblong, 25—30×18—22μ, rounded at both ends, wall 2μ thick, light brown, strongly verrucose, tubercles 2.5μ apart, upper pore at or near the apex, the lower from the middle of the cell to near the pedicel, conspicuous; pedicel hyaline, fragile, slender, to 30μ long.

On Hydrophyllum Virginicum L. N.Y., Minn., Iowa; H. capitatum Dougl. Utah; H. Watsoni (A. Gray). Rydb. Utah.

Photo: No. 171. From H. capitatum. Utah, ×500.

Type: N.Y. Lower surface of living leaves of Hydrophyllum Virginicum. Buffalo, Clinton.

Exsiccati: Barth., Fungi Columb. *1855*; Barth., N.A. Ured. *346*; Sydow, Ured. *1927*; Garrett, Fungi Utah *30, 81*; Vestergren Micromycetes *968*; Ellis, N. A. F. *1043*; Carlton, Ured. Am. *16*.

PHACELIA.

172. Puccinia Phaceliae Syd. et Holw.

Monogr. Ured. 1:314. 1902.

III. Teleutosori amphigenous, dark brown, confluent in round groups 1—3mm. in diameter, firm, surrounded by numerous dark brown paraphyses; teleutospores oblong or clavate, 37—54×18—27μ, not at all or strongly constricted, upper cell usually larger, the lower cell narrowed from the septum, apex rounded or truncate, darker in color and to 5μ thick, wall very thin, smooth, pores not apparent; pedicel short, brown, persistent.

On Phacelia heterophylla Pursh. (P. circinata A. Gray). Wash. Mt. Ranier.

Photo: No. 172. From the type, ×500.

Type: Washington. In foliis vivis Phaceliae circinatae in Monte Tacoma. (Holway.)

Exsiccati: Barth., N.A. Ured. *1464*.

Known only from the type collection. One-celled teleutospores are numerous.

Sydow says: "Auf derselben Nährpflanze lebt auch das Aecidium Phaceliae Peck. Sollte dieses vielleicht zu der Puccinia gehören?" This aecidium, however, has been shown to belong to Puccinia montanensis on Elymus.

BORRAGINACEAE.

CORDIA.

173. Puccinia Cordiae (P. Henn.) Arth.

Mycologia 8:17. 1916.

Syn: Uredo Cordiae P. Henn. Hedw. 43:163. 1904.

O. Amphigenous, scattered, subepidermal, with the primary uredosori only.

II. Primary uredosori hypophyllous with rather longer uredospores and without paraphyses; secondary uredosori hypophyllous, scattered, dark brown, round, 0.2—0.4mm. across, surrounded by thin-walled hyaline paraphyses; uredospores variable, globoid, elliptical, oblong or angular, 20—40×20—25μ, wall 2.5μ thick, closely and strongly verrucose, apex often 5—10μ thick, occasionally a little thickened at the hilum, yellowish or tinted brown above, pores inconspicuous (3—4?).

III. Teleutosori black, hypophyllous, scattered; teleutospores of two kinds, one globoid or mostly elliptical, rarely oblong, 32—47×25—27μ, wall 3—4μ thick, dark mahogany-red, coarsely verrucose, almost echinulate, tubercles 2.5—5μ apart, cells rounded at both ends or the lower narrowed, not constricted; intermixed are the more numerous yellowish-brown teleutospores, less strongly verrucose, with thinner walls, 2μ thick, many of them narrower, 17—27μ wide; pedicel hyaline, to 75μ long, enlarging in water about the middle to a globose form, 15—18μ wide and easily breaking off below this swelling. Germ pores not apparent.

On Cordia gerascanthus L. Guatemala; C. alliodora (R. & Pav.) Cham. Porto Rico.

Photo: No. 173. On C. gerascanthus, ×500.

Type: Porto Rico. On Cordia alliodora, Ponce. January, 1911. Holway.

Very little of the primary uredosori was collected. When well developed, as in Henning's material, it forms gall-like swellings on the leaves and shoots, resulting in witches'-brooms.

CRYPTANTHE.

174. Puccinia Cryptanthes Diet. et Holw.

Erythea 1:249. 1893.

II. Uredosori light brown, 1—2mm. long, seen on the stems only; uredospores globoid, 25—28×22—25μ, wall 2.5μ thick, echinulate, light brown, pores 2, equatorial.

III. Teleutosori as the uredosori but black, pulvinate, at first covered with the epidermis, remaining firm, often confluent in groups 3—5mm. long; teleutospores elliptical to oblong, 37—50×20—27μ, apex rounded or truncate, rarely pointed, 6—10μ thick, wall 2.5μ thick, dark brown, smooth, somewhat constricted at the septum, pores not apparent; pedicel hyaline, persistent, to 90μ long.

On Cryptanthe Torreyana (Gray) Greene. Wash., Calif.; C. flaccida (Lehm) Greene. Calif.

Photo: No. 174. Teleutospores from the type, ×500.

Type: California. On Cryptanthe Torreyana. Camp Badger, July, 1892. Holway.

Exsiccati: Barth., N.Am. Ured. *1235*.

HELIOTROPIUM.

175. Puccinia Heliotropii Kern & Kellerm.

Jour. Mycol. 13:23. 1907.

III. Spots yellow, teleutosori brown, hypophyllous, thickly scattered over the leaf or crowded in round groups 1—4mm. in diameter, central spores soon germinating; teleutospores oblong, 35—50×14—20μ, apex rounded or pointed, 2.5—5μ

thick, lower cell narrowed, wall 1μ thick, pale brown, smooth, upper pore at the apex, the lower not apparent; pedicel hyaline, firm, 25—50μ long.

On Heliotropium indicum L. Guatemala.

Photo: No. 175. From collection made by Holway, ×500.

Type: Guatemala. On H. indicum. Gualan, Department of Zacapa, Kellerman.

This was very abundant along the railway at Sanarate, Department of Guatemala, in 1916; at about the same time in 1917 not a specimen could be found.

LAPPULA. MERTENSIAE.

176. Puccinia Mertensiae Peck.

Bot. Gaz. 6:227. 1881.

Syn: Dicaeoma Mertensiae Kuntze. Rev. Gen. 3^3:469. 1898.

III. Sori amphigenous, 0.5mm. in diameter, early naked and confluent in round or irregular groups, elongated along the veins, stems and petioles, brown; teleutospores globoid to elliptical, 25—32×18—25μ, wall uniformly 2μ thick, yellowish-brown, strongly and closely verrucose, pores inconspicuous, the upper at the apex, the lower from the middle of the cell to near the pedicel, which is hyaline, fragile, about the length of the spore.

On Mertensia arizonica Greene. Utah; M. siberica Don., Utah; M. oblongifolia Don., Nev.; M. cynoglossoides Greene. Colo.; M. polyphylla Greene. Colo.; Lappula floribunda Greene. Utah, Alberta.

Photo: No. 176. From Mertensia arizonica. Utah, ×500.

Type: Colorado. On living leaves of Mertensia siberica, Brandegee.

Much like Puccinia Hydrophylli in sori and spores, differing chiefly in the inconspicuous pores.

Exsiccati: Clements, Crypt. Colo. *571*; Sydow, Ured. *1931*; Vestergren, Micromycetes *970*; Garrett, Fungi Utah. *166*.

VERBENACEAE.

LANTANA.

177. Puccinia tuberculata Speg.

*Anal. Soc. Ci. Argent. 10:6. 1880.
(Page 11, in the separate.)

Syn: Uredo tuberculata Speg. Anal. Soc. Ci. Argent. 9:172. 1880.
Prospodium tuberculatum Arth. N.Am. Flora 7:161. 1912.

II. Uredosori hypophyllous, brown, 0.25—5mm. across, scattered; paraphyses peripheral, hyaline, wall thin, straight or clavate, 37—50×10—12μ; uredospores globoid, 25—30μ in diameter, wall evenly 2.5—3μ thick, yellowish-brown, echinulate, spines 2.5—4μ apart, pores 2, equatorial.

III. Teleutosori amphigenous or hypophyllous, scattered, black, 0.5—1mm. in diameter, pulverulent; teleutospores broadly elliptical, 45—50×35—38μ, rounded at both ends, wall 6—8μ thick, deep brown, verrucose, tubercles low and rounded, 3—4μ apart, upper pore at the apex, the lower at the pedicel, with broad yellowish papillae, making the apex 10μ thick; pedicel hyaline, 6—8 wide, to 90 long, with one or two rows of slightly branched appendages near the base, often imperfectly developed.

On Lantana horrida H.B.K. Mexico; Lantana Camara L. Mexico, Costa Rica; Lantana Sp. Guatemala.

Photo: No. 177. Teleutospores from Lantana Camara. Mexico, ×500.
Type: Argentina. Ab folia viva Lantanae Camarae cerca de la Recoleta.
Exsiccati: Barth., N.Am. Ured. *473, 474, 615.*

LANTANA. LIPPIA.

178. Puccinia Lantanae Farlow.

Am. Acad. Arts & Sci. 18:83. 1883.

Syn: Dicaeoma Lantanae Kuntze. Rev. Gen. 3³:469. 1898.
Dasyspora Lantanae Arth. Result. Sci. Congr. Bot. Vienne 347. 1906.

III. Spots brown or yellow; teleutosori hypophyllous, 9.5mm. in diameter, somewhat circinate, in round or irregular groups, 2—4mm. in diameter, dark brown; two-celled teleutospores few, 30—37×17—25μ, rounded at both ends, wall 2.5μ thick in the lower cell, increasing to 4μ thick at the apex, clear brown, smooth, pores not apparent; pedicel tinted, persistent, to 45μ long; one-celled teleutospores ovoid or globoid, 22—37×17—27μ.

On Lantana purpurea Jacq. Mexico; L. Camara L. Cuba, Porto Rico, Costa Rica; L. involucrata L. Fla., Cuba, Bahamas; L. odorata L. Fla., Bermuda; L. hispida H.B.K. Costa Rica; Lippia staechadifolia (L.) H.B.K. Cuba.

Photo: No. 178. From Lantana purpurea, Mexico, ×500.
Type: Bermuda. On leaves of Lantana odorata. Farlow, 1881.
Distribution: So. U.S., Bermuda, West Indies, Mexico, Central America, S.Am.
Exsiccati: Ellis, N.A.F. *1052*; Barth., N.A. Ured. *645, 646, 749, 1161.*

In some collections the spores are nearly all one-celled.

LIPPIA.

179. Puccinia Lippiae Speg.

Anal. Mus. Nac. Buenos Aires 6:224. 1898.

Syn: Uredo Lippiae Speg. l. c. :238. 1898.
Uredo Lippiae Diet. & Holw. Bot. Gaz. 31:335. 1901.
Prospodium Lippiae Arth. N.Am. Flora 7:161. 1912.

II. Uredosori minute, mostly hypophyllous, scattered, cinnamon-brown, paraphyses peripheral, thin-walled; uredospores globoid, yellowish-brown, 25—30μ in diameter, wall 3—4μ thick, sometimes thinner at the pores, echinulate, spines rather long and sharp, 2.5—5μ apart, pores 2, equatorial.

III. Teleutosori mostly hypophyllous, black, 1.5—2mm. wide, in small irregular groups, not confluent, soon pulverulent; teleutospores broadly elliptical, 37—45×30—33μ, rounded at both ends, wall 5μ thick, dark brown with yellowish outer layer, strongly verrucose, tubercles 2.5—5μ apart, upper pore at the apex, the lower near the pedicel, each with a broad yellowish papilla, making the apex to 8μ thick; pedicel hyaline, persistent, to 90μ long, with 3—4 whorls of branched appendages, fully developed in few specimens.

On Lippia strigosa Turcz. Guatemala; L. myriocephala Schl. & Cham. Costa Rica, Guatemala; L. Pringlei Briq. Mexico; L. umbellata Cav. Guatemala; L. asperifolia Rich. Guatemala; L. callicarpaefolia H.B.K. Mexico.

Photo: No. 179. From L. callicarpaefolia, Mexico, ×500.

Type: Argentina. In foliis languidis Lippiae lycioidis, in horto meo, La Plata, January, 1898.

Exsiccati: Barth., N.Am. Ured. *1187*.

Distribution: Central Mexico, Central and S.Am.

Some specimens have few tubercles in the middle of the spore; those on L. myriocephala have thinner-walled uredospores and the appendages are poorly developed, with mostly 2, rarely 3, whorls, but do not seem to be separable from this species.

180. Puccinia conjuncta Diet. et Holw.

Bot. Gaz. **31**:335. 1901.

Syn: Nephlyctis conjuncta Arth. N.Am. Flora **7**:163. 1912.

O. Spermogonia chiefly epiphyllous, inconspicuous, mostly covered by the teleutospores.

III. Teleutosori nearly all epiphyllous, scattered or confluent in irregular groups or elongated on the stems, dark brown, soon pulverulent; teleutospores ellipsoid, 36—52×20—27μ, rounded at both ends, strongly constricted and easily separating into nearly equal globose cells, wall 2.5μ thick, cinnamon-brown, strongly verrucose, tubercles 2.5—5μ apart, the upper pore at the apex with a broad hyaline papilla making it 3—6μ thick, the lower pore near the pedicel, which is hyaline, short, easily breaking near the spore.

On Lippia Pringlei Briq. Oaxaca, Mexico, Oct. 24, 1899. Holway. Known only from the above locality. A second collection was made there Nov. 12, 1899.

Photo: No. 180. From the type, ×500.

Exsiccati: Barth., N.A. Ured. *1316*.

STACHYTARPHETA.

181. Puccinia Urbaniana P. Henn.

Hedw. **37**:278. 1898.

III. Spots, brown; teleutosori hypophyllous, minute, brown, closely crowded in round or irregular groups 2—5μ across, central sori soon germinating; teleutospores elliptical to oblong, occasionally constricted, extremely variable in size, 30—50 ×16—25μ, one-celled spores numerous, upper cell rounded, the lower narrowed or rounded, wall 1—2μ thick in the lower cell, often increasing in thickness in

the upper cell, apex 3—6μ thick, clear brown, smooth, pores not apparent; pedicel firm, tinted 20—40μ long.

On Stachytarpheta Jamaicensis (L.) Vahl. Porto Rico, Jamaica, Bahamas, Cuba, Fla.; S. cayennensis Vahl. Costa Rica; Cornutia grandifolia Schauer. Guatemala.

Photo: No. 181. From a Cuban specimen, ×500.

Type: Jamaica: Port Antonio auf Blättern con Stachytarpheta Jamaicensis Vahl. 7 März, 1893.

Exsiccati: Barth., N.Am. Ured. *669*, *1672*.

PLATE 45

Dodecatheon.

144. Puccinia [illegible] (L. & Everh.). On Dodecatheon cruciatum, Calif., ×500.

144a. Puccinia Cotoni Jackson. On Dodecatheon jeffreyi, Vancouver Island, ×[illegible].

145. Puccinia Cotoni Jackson, ×500.

Sreironema.

146. Puccinia Dayi [illegible]. On Sreironema ciliatum, Wis., ×500.

Gentiana.

147a. Puccinia Gentianae [illegible]. On Gentiana affinis, Colo., ×500.

147b. Puccinia Gentianae [illegible]. On G. Bigelowii, Colo., ×500.

PLATE 45

Dodecatheon.

144. Puccinia melanconioides Ell. & Everh. On Dodecatheon cruciatum, Calif., ×500.

145a. Puccinia Ortoni Jackson. On Dodecatheon Jeffreyi, Vancouver Island, ×500.

145b. Puccinia Ortoni Jackson, ×500.

Steironema.

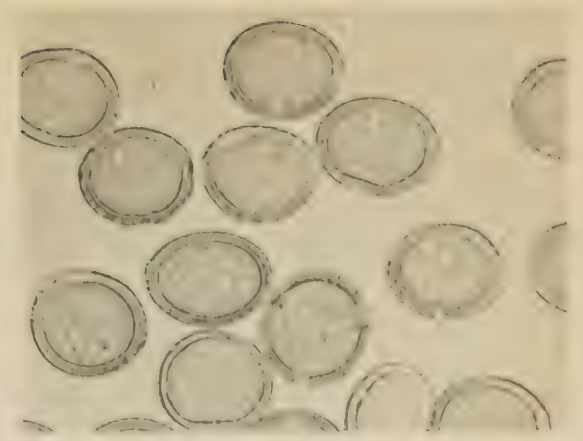
146. Puccinia Dayi Clinton. On Steironema ciliatum, Wis., ×500.

Gentiana.

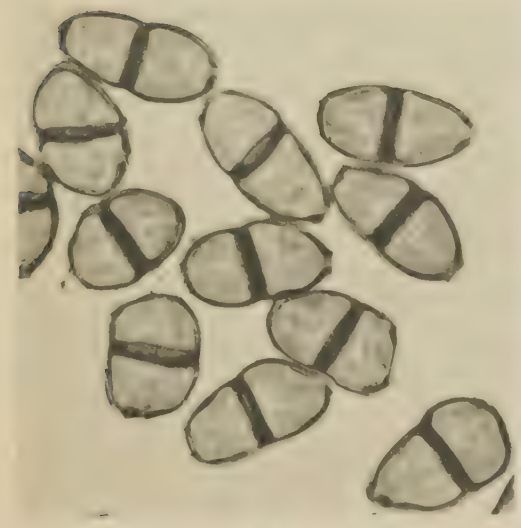
147a. Puccinia Gentianae (Strauss) Lk. On Gentiana affinis, Colo., ×500.

147b. Puccinia Gentianae (Strauss) Lk. On G. Bigelowii, Colo., ×500.

144

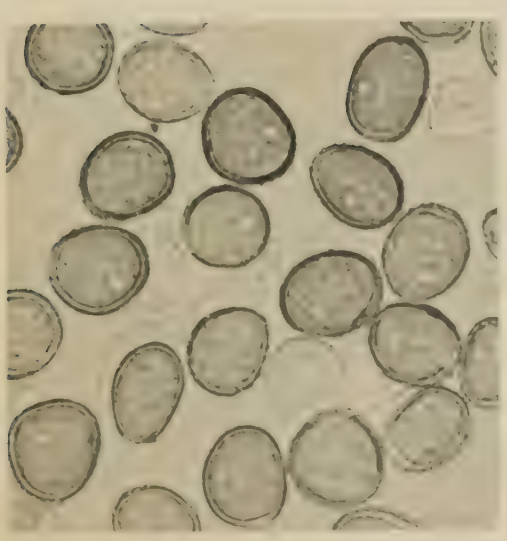


145 a

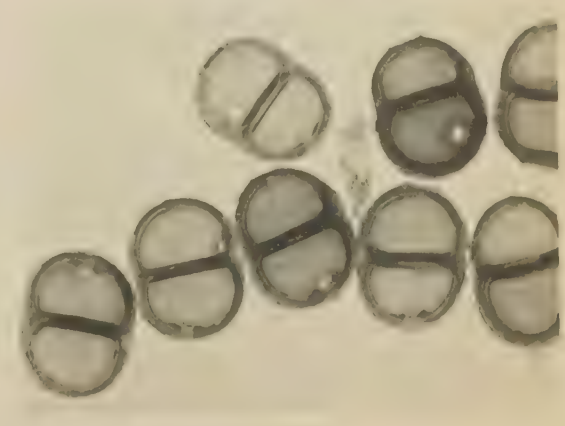


145 b

146



147 a



147 b

PLATE 46

151b. Puccinia Gonolobi Rav. On Gonolobus sp., Mexico, ×500.

PLATE 46

Gentiana—Continued

147c. Puccinia Gentianae (Strauss) Lk. On Gentiana affinis, Mont., ×500.

Haleniae.

148. Puccinia Heleniae Arth. & Holw. From type, ×500.

Swertia.

149. Puccinia Swertiae (Opiz) Wint. On Swertia scopulina, Colo., ×500.

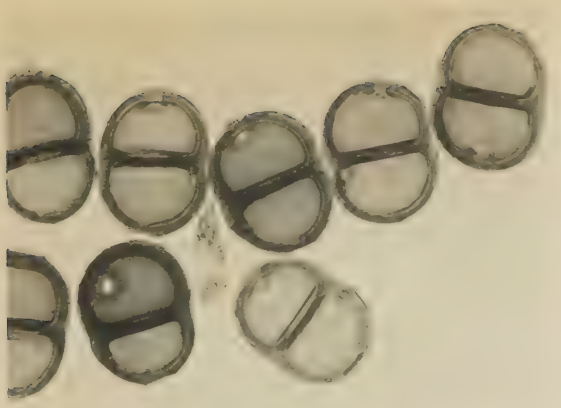
Asclepias.

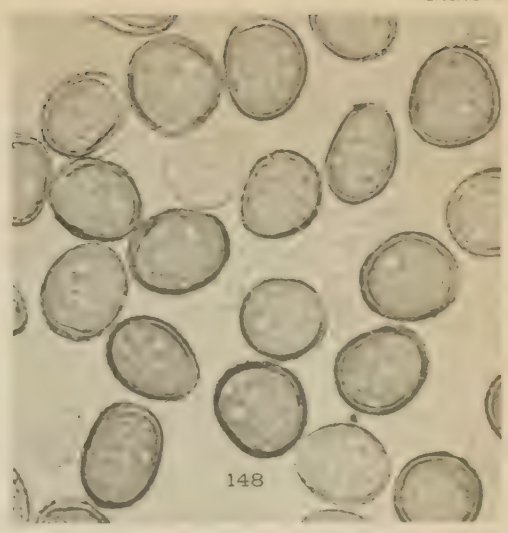
150. Puccinia concrescens E. & E. On Asclepias curassavica, Porto Rico, ×500.

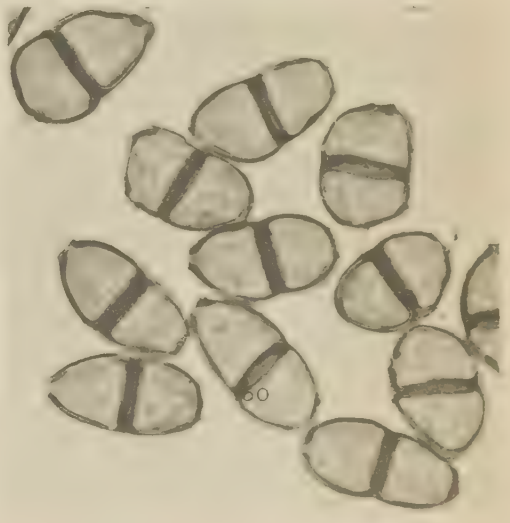
Gonolobus. Philibertia. Vincetoxicum.

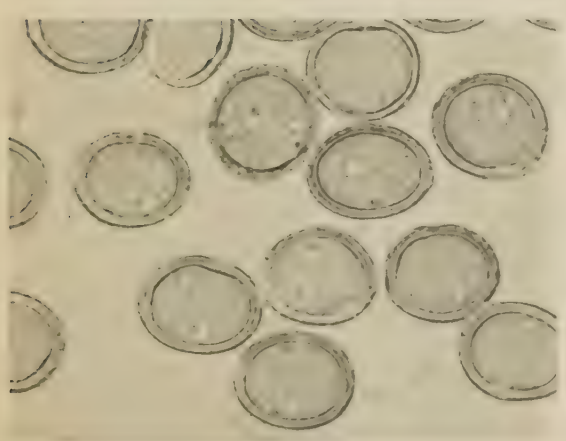
151a. Puccinia Gonolobi Rav. On Gonolobus laevis, S.C., ×500.

151b. Puccinia Gonolobi Rav. On Gonolobus sp., Mexico, ×500.

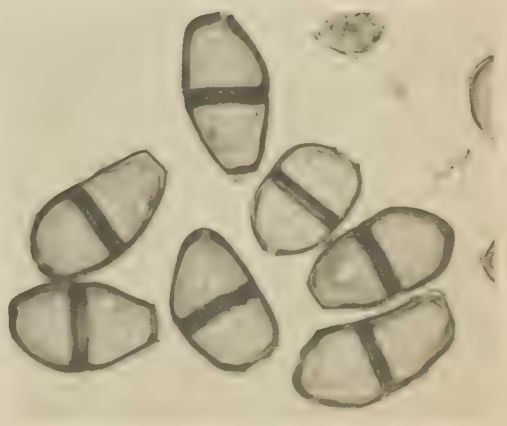








151 a



151 b

PLATE 47

Gonolobus. Philibertia. Vincetoxicum—Continued

151c. Puccinia Gonolobi Rav. On Philibertia viridiflora. Type of P. Philibertiae, ×500.

151d. Puccinia Gonolobi Rav. On Philibertia cyanchoides, New Mexico, ×500.

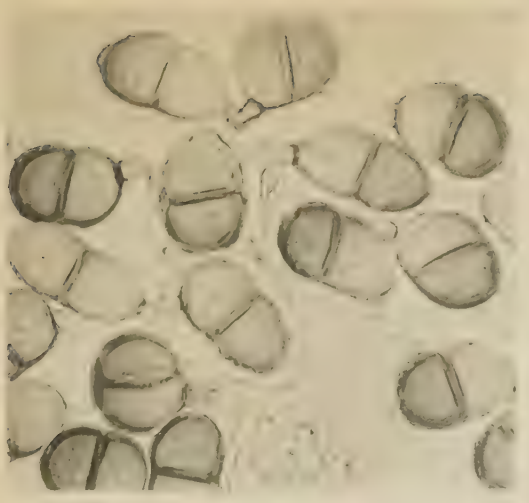
Metastelma. Philibertia. Vincetoxicum.

152a. Puccinia obliqua B. & C. From type, ×500.

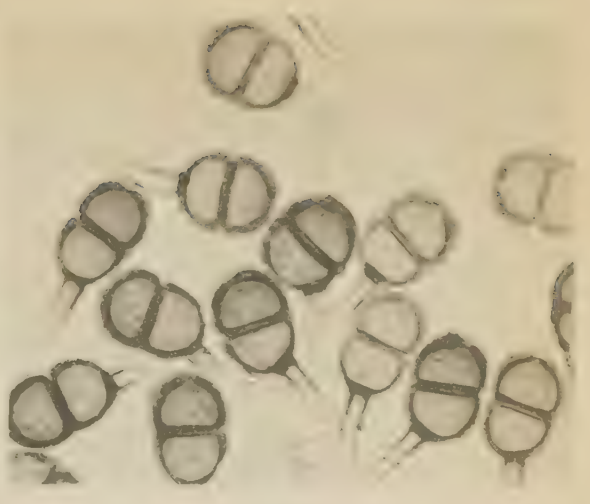
152b. Puccinia obliqua B. & C. On Metastelma Schlechtendalii, St. Croix, ×500.

152c. Puccinia obliqua B. & C. Type of P. subcollapsa, Paraguay, ×500.

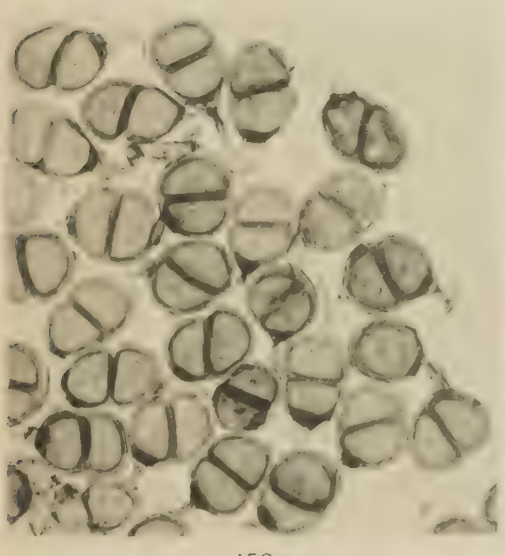
152d. Puccinia obliqua B. & C. On Philibertia crassifolia, Mexico, ×500.



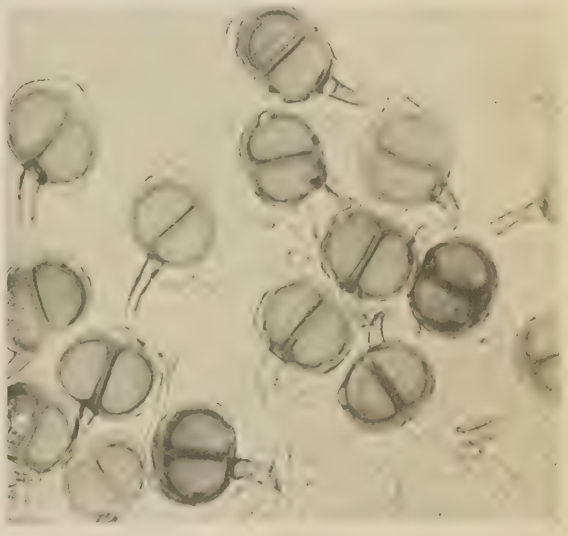
151 c



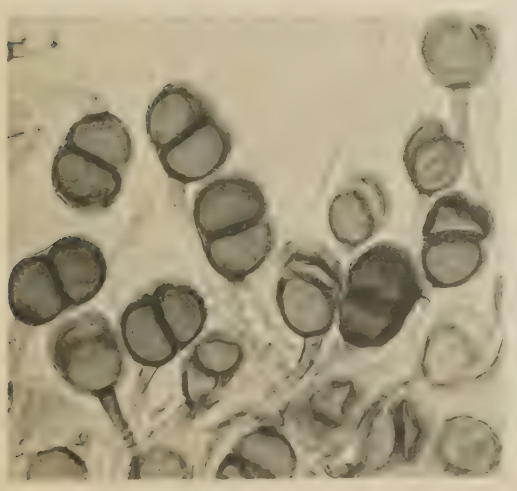
151 d



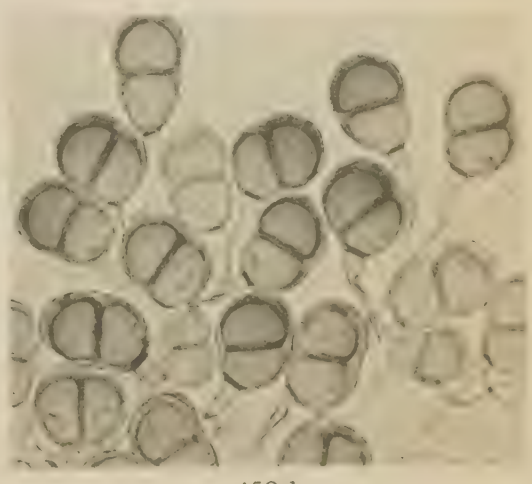
152 a



152 b



152 c



152 d

Puccinia Convolvuli (Pers.) Cast. Seymour & Earle, Econ. Fungi 332A, ×500.

PLATE 48

Metastelma. Philibertia. Vincetoxicum—Continued

152e. Puccinia obliqua B. & C. On Metastelma angustifolium, Mexico, ×500.

152f. Puccinia obliqua B. & C. From Puccinia Cynanchi, Venezuela, ×500.

Marsdenia.

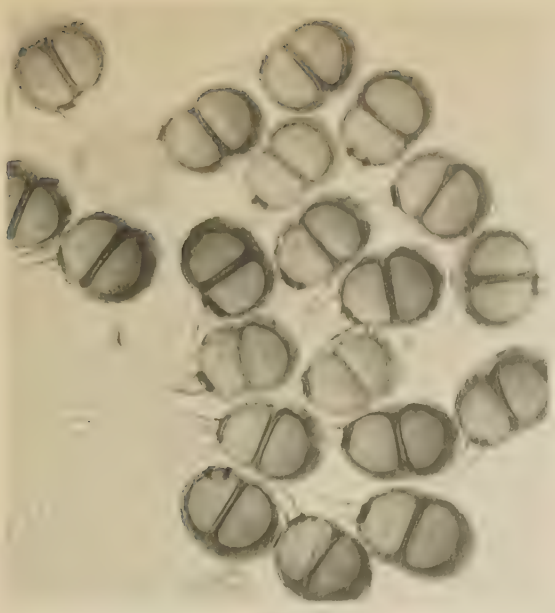
153a. Puccinia Marsdeniae Diet. & Holw. From type, Mexico, ×500.

153b. Puccinia Marsdeniae Diet. & Holw. From type, Mexico, ×500.

Convolvulus. Ipomoea.

154a. Puccinia Convolvuli (Pers.) Cast. From Fungi Columb. 2354, ×500.

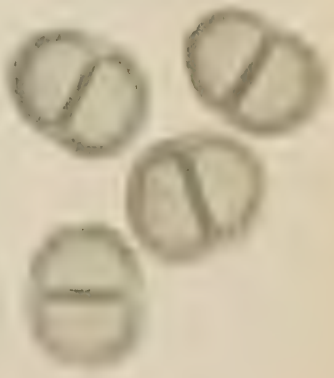
154b. Puccinia Convolvuli (Pers.) Cast. Seymour & Earle, Econ. Fungi 332A, ×500.



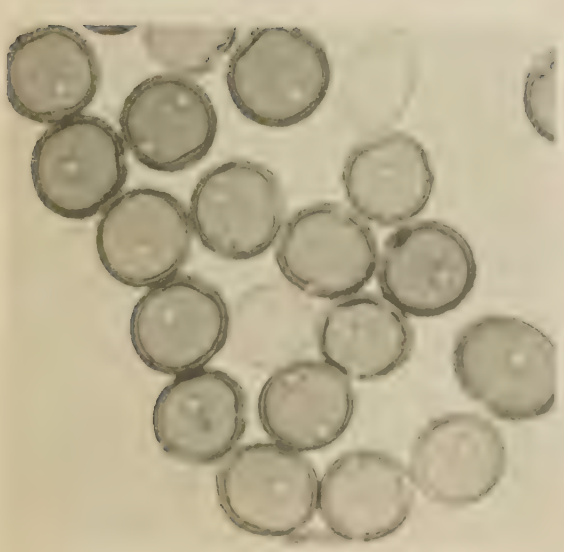
152 e

152 f

153 a



153 b



154 a

154 b

PLATE 49

Cruciferæ.

158. Puccinia crassipes B. & C. On Ipomœa sp., Fla., ×250.

PLATE 49

Cressa.

155a. Puccinia Cressae (DC) Lagerh. From type, ×500.

155b. Puccinia Cressae (DC) Lagerh., ×500.

155c. Puccinia Cressae. From type of Puccinia cretica, ×500.

Dichondra.

156. Puccinia Dichondrae Mont. On Dichondra repens, Calif., ×500.

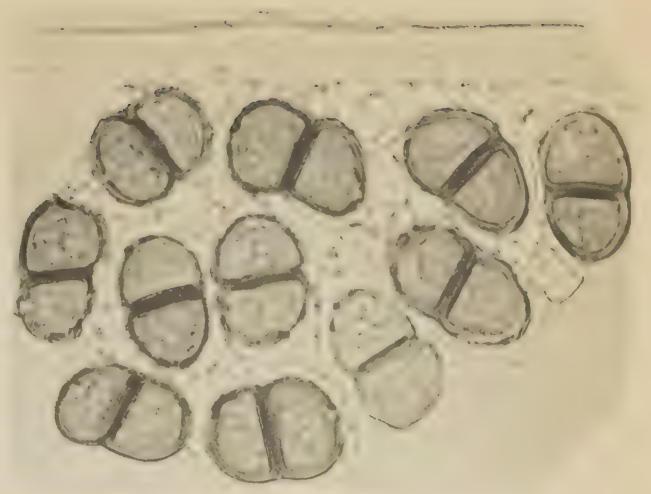
Evolvulus.

157. Puccinia Lithospermi Ellis & Kellerm. From Fungi Columb. 2151, ×500.

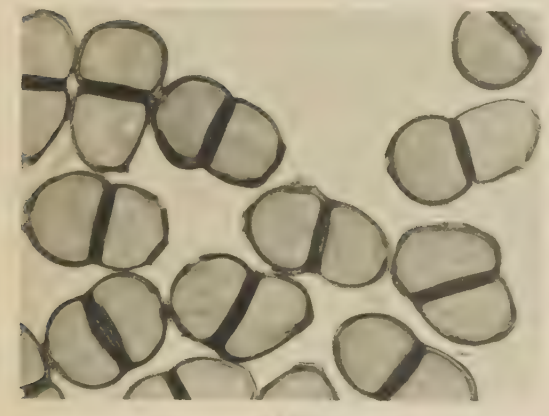
Ipomoea.

158. Puccinia crassipes B. & C. On Ipomoea sp., Fla., ×500.

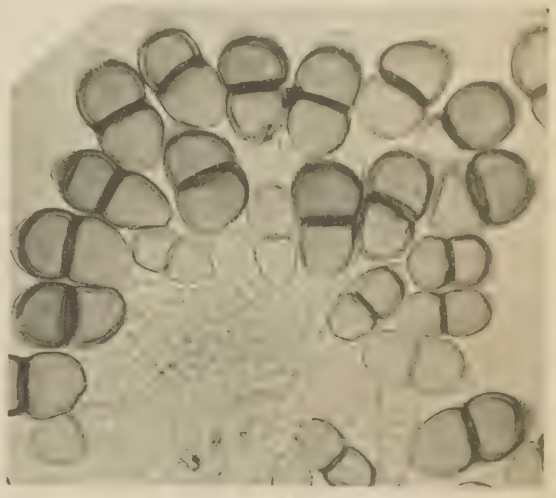
155 a



155 b

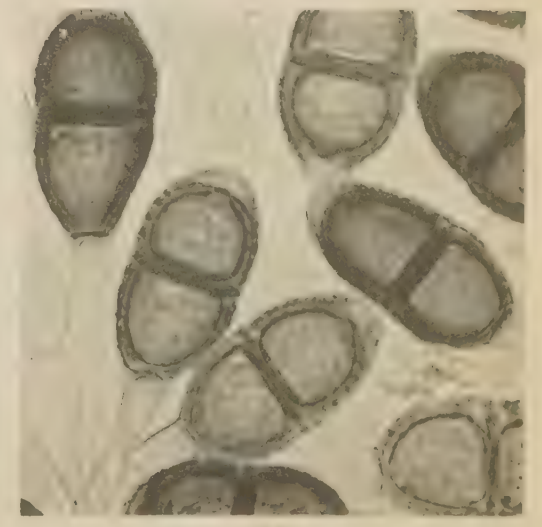


155 c



156

157



158

PLATE 50

Ipomoea—Continued

159. Puccinia nocticolor Holw. From type, ×500.

160. Puccinia megalospora (Orton) Arth. & Johnst. From type, ×500.

161. Puccinia rubicunda Holw. From type, ×250.

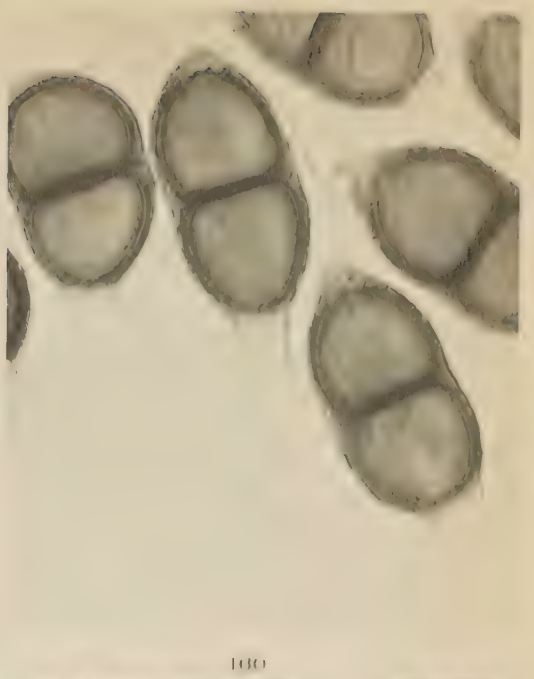
162. Puccinia superflua Holw. From type, ×250.

163. Puccinia insignis Holw. From type, ×500.

Gilia.

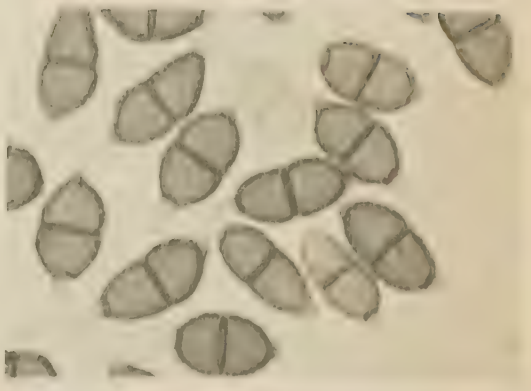
164. Puccinia giliicola P. Henn. From Fungi eur, *4221*, ×500.

159



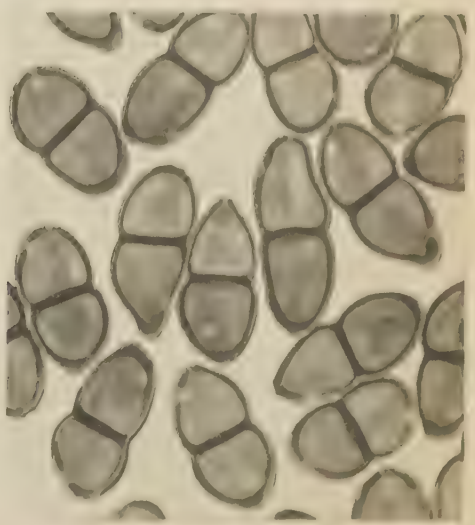
160

161



162

163



164

PLATE 51

Collomia. Gilia.

165. Puccinia Giliae Harkness. On G. atractyloides Calif., ×500.

Phlox.

166a. Puccinia Douglasii Ell. & Everh. From type, ×500.

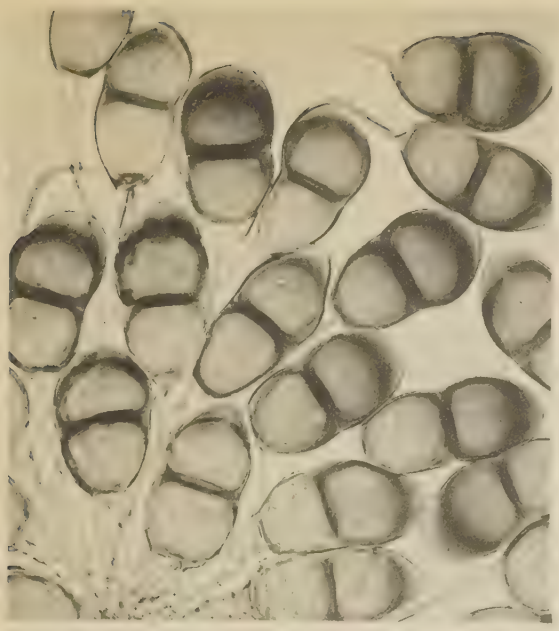
166b. Puccinia Douglasii Ell. & Everh. On Phlox procumbens, Penn., ×500.

166c. Puccinia Douglasii Ell. & Everh. From type coll. of P. Richardsonii Syd., ×500.

Collomia. Gilia.

167a. Puccinia plumbaria Peck. From type, ×500.

167b. Puccinia plumbaria Peck. From type of P. Purpusii, ×500.

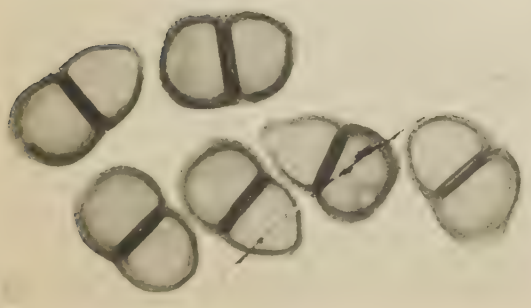


165

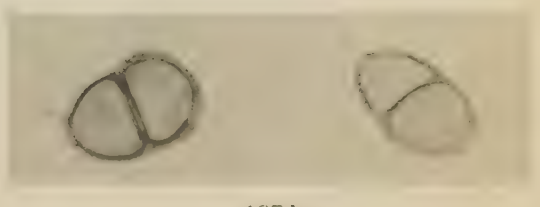
166 a

166 b

166 c



167 a



167 b

PLATE 82

Collomia. Gilia—Continued

12a. [illegible] On Gilia gracilis, Calif., ×500.

Phlox.

[illegible]

Polemonium.

[illegible]

PLATE 52

Collomia. Gilia—Continued

167c. Puccinia plumbaria Peck. On Gilia gracilis, Calif., ×500.

Phlox.

168a. Puccinia fragilis Tracy & Hall. From type, ×500.

168b. Puccinia fragilis Tracy & Hall. From Plants of Colo. 423A, ×500.

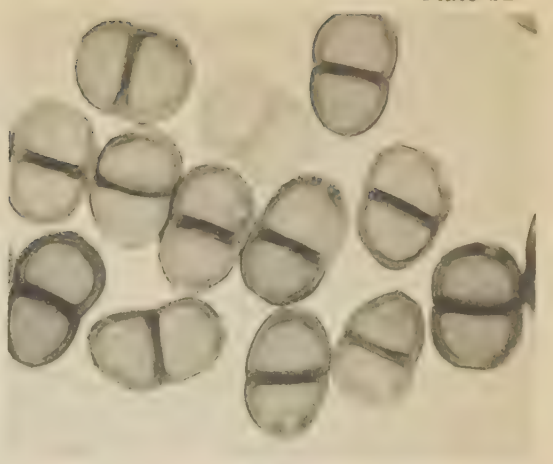
168c. Puccinia fragilis Tracy & Hall. From type of P. arabicola, ×500.

168d. Puccinia fragilis Tracy & Hall. On Phlox divaricata, Iowa, ×500.

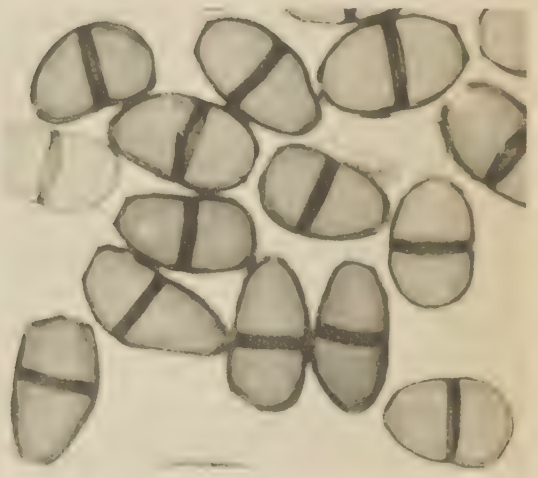
Polemonium.

169. Puccinia Polemonii. Diet. & Holw. From type, ×500.

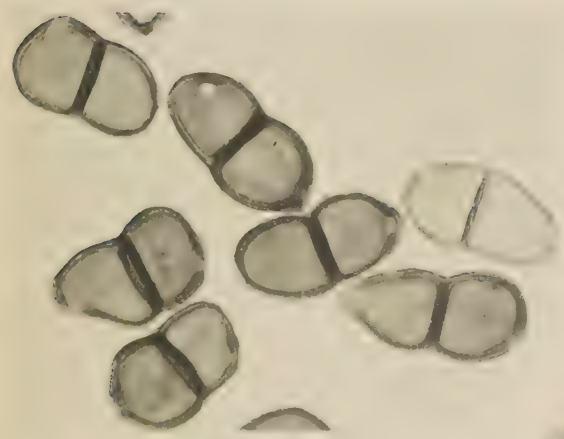
167 c



168 a



168 c



168 b

168 d

169

PLATE 53

Loeselia.

170. Puccinia fumosa Holw. From type, ×500.

Hydrophyllum.

171. Puccinia Hydrophylli Peck & Clinton. On Hydrophyllum capitatum, Utah, ×500.

Phacelia.

172. Puccinia Phaceliae Syd. et Holw. From type, ×500.

Cordia.

173. Puccinia Cordiae (P. Henn.) Arth. On Cordia gerascanthus, Guatemala, ×500.

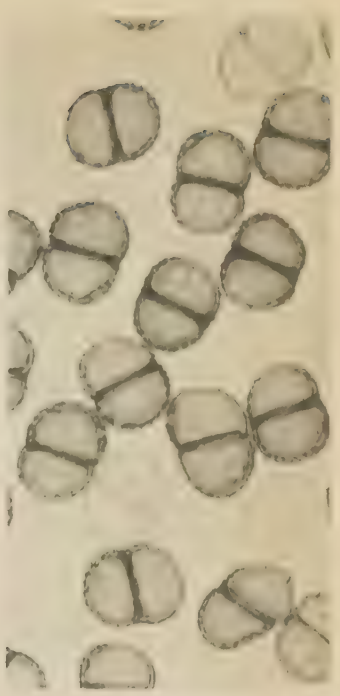
Cryptanthe.

174. Puccinia Cryptanthes Diet. & Holw. From type, ×500.

Heliotropium.

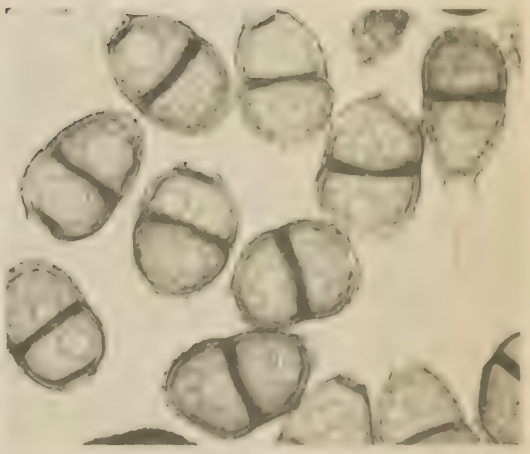
175. Puccinia Heliotropii Kern & Kellerm. On Heliotropium indicum, Guatemala, ×500.

170

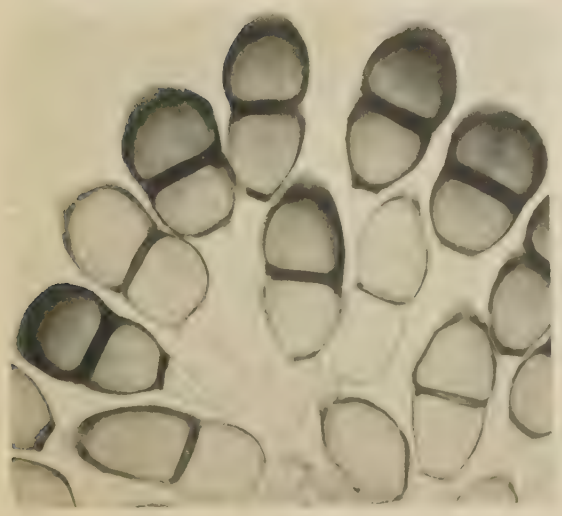


171

172



173



174

175

PLATE 54

Lappula. Mertensiae.

176. Puccinia Mertensiae Peck. On *Mertensia arizonica*, Utah, ×500.

Lantana.

[illegible]

Lantana. Lippia.

[illegible]

Lippia.

179. Puccinia Lippiae Spegk. On *Lippia callicarpaefolia*, Mexico, ×500.

180. Puccinia conjuncta Diet. & Holw. From type, ×500.

Stachytarpheta.

181. Puccinia Urbaniana P. Henn. From a C[illegible]

PLATE 54

Lappula. Mertensiae.

176. Puccinia Mertensiae Peck. On Mertensia arizonica, Utah, ×500.

Lantana.

177. Puccinia tuberculata Speg. On Lantana Camara, Mexico, ×500.

Lantana. Lippia.

178. Puccinia Lantanae Farlow. On Lantana purpurea, Mexico, ×500.

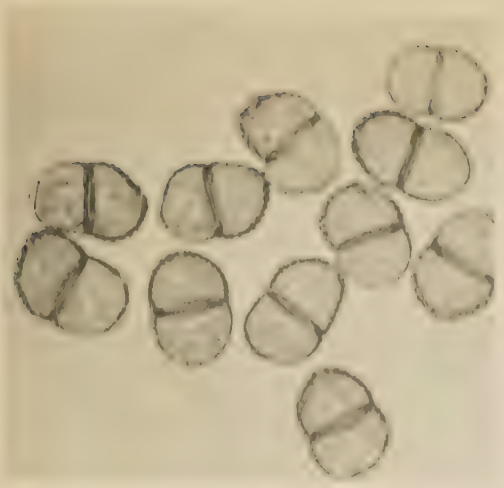
Lippia.

179. Puccinia Lippiae Speg. On Lippia callicarpaefolia, Mexico, ×500.

180. Puccinia conjuncta Diet. & Holw. From type, ×500.

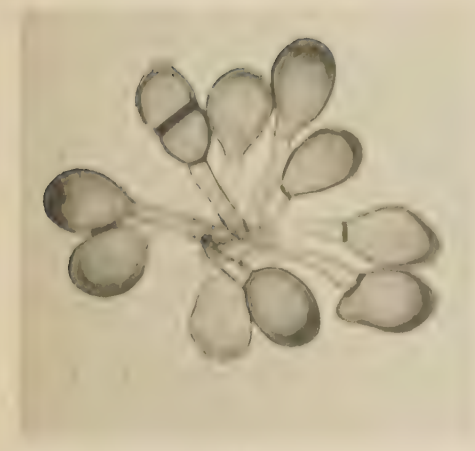
Stachytarpheta.

181. Puccinia Urbaniana P. Henn. From a Cuban spec., ×500.

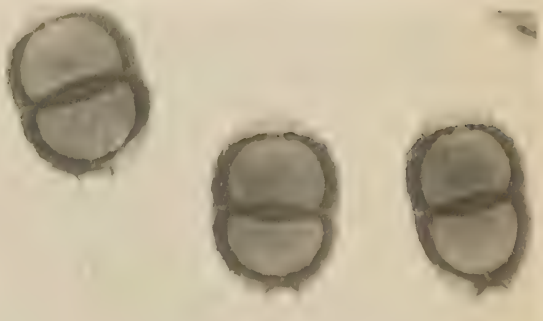


176

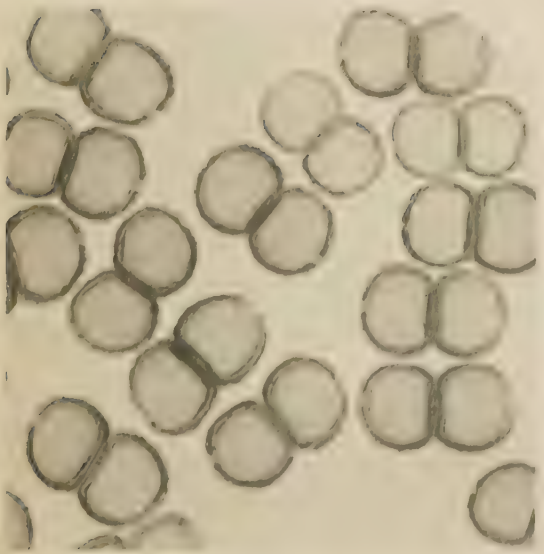
177



178



179



180

181

INDEX

INDEX TO HOST PLANTS

Page

Abutilon 65
Holwayi 65
Adoxa 63
moschatellina 63
Aletris 28
aurea Walt. 28
farinosa L. 28
Allium 22, 23, 24, 26
acuminatum Hook. 23
cepa 27
cernuum Roth 23
Geyeri Wats. 22
mutabile Michx. 22
reticulatum Don. 22
sativum 23
serratum Wats. 23
Althaea 64, 66, 67
rosea Cav. 65, 66, 67
Amarantaceae 40, 41
Amaryllidaceae 29, 30
Anemone 8, 10, 56
canadensis L. 10
Caroliniana Walt. 8
cylindrica Gray 10
Drummondii 9, 10
globosa Nutt. 11
multifida 12
narcissiflora L. 11
parviflora Michx. 9, 10, 12
quinquefolia L. 9
Virginiana L. 10
Angelica 37, 87, 88, 89, 90
ampla A. Nelson 88
dilatata A. Nelson 90
genuflexa Nutt. 89, 90
Grayi C. & R. 88
tomentosa Wats. 90
Anoda 65
Arabis 44, 46, 47, 112
ambigua intermedia DC. 44
arcuata Gray 44
Drummondii Gray 44
furcata Wats. 44
Holboellii Hornem 44, 45
Lyallii Wats. 44
perennans Wats. 44
Suksdorfii Howell 44
Aralia 81
Araliaceae 81
Arenaria 43, 44
Fendleri Gray 43
Peyritshii Rohrb. 44
pungens 112
reptans Hemsl. 44
Uintahensis A. Nels. 43
verna L. 43
Arracacia 85
Hartwegi S. Wats. 85
multifida Wats. 85
Aristolochiaceae 34
Asarum 34
caudatum Lindl. 34
Lemmoni Wats. 34
majus (Ducharte) Heller 34
Asclepiadaceae 100, 101, 102, 103
Asclepias 100
Curassavica 101
Asparagus 27
officinalis L. 27
Aulospermum 90
Betheli Osterh. 91
purpureum (Wats.) C. & R. 91

Balsaminaceae 62, 63
Bellis perennis 19
Berberidaceae 15, 16, 17
Berberis 15
Aquifolium Pursh 15
nana Greene 15
nervosa Pursh 15
pinnata Lag. 15
pumila Greene 15
trifolia Schult. 16
trifoliolata Moricand 16
Boisduvalia 76, 77
densiflora (Lindl.) Wats. 77

Boisduvalia—*Continued* Page
glabella (Nutt.) Walp. 76
Torreyi Wats. 77
Bomarea 30
acutifolia Benth. 30
ovata Mirb. 30
Borraginaceae 114, 115, 116
Brodiaea 24
capitata Benth. 24, 26
congesta Smith 25
Bromeliaceae 17, 18

Calochortus 26
albus Dougl. 26
elegans Pursh 26
Gunnisonii Wats. 26
longebarbatus Wats. 26
Nuttallii T. & G. 26
Caltha 5
biflora DC. 7
chionophila Greene 7
Howellii Greene 6
leptosepala DC 6, 7
palustris L. 5, 6
rotundiflora (Huth.) Greene 7
Capnoides 17
Brandegei (Wats.) Heller 17
Cardiospermum 62
Halicacabum L. 62
microcarpum H. B. K. 62
velutinum 62
Carum 37, 87, 88
Garrettii A. Nels. 88
Caryophyllaceae 42, 43, 44
Cerastium 42
arvense 43
Chaerophyllum 83
procumbens (L.) Crantz 83
Chamaenerion 74
angustifolium (L.) Scop. 74
Cheiranthus 44
pygmaeus Adams 44
Cherry 56
Chick-weed 43, 102
Chrosperma 20
muscaetoxicum (Walt.) Kuntze 20
Chrysoplenium 48
Cicuta 85, 86
Curtissii C. & R. 86
Cicuta occidentalis Greene 86
vagans Greene 86
virosa 86
Circaea 79
alpina L. 79
Lutetiana L. 79
Pacifica Aschers. & Magnus 79
Clarkia 76, 77
elegans Lindl. 77
rhomboidea Dougl. 77
Claytonia 41
Caroliniana Mx. 42
megarrhiza (A. Gray) Parry 42
Virginica 42
virginiana L. 42
Clematis 12
Clintonia 28
borealis (Ait.) Raf. 28
uniflora (Menzies) Kunth. 28
Collomia 110, 111, 112
gracilis 111
grandiflora Dougl. 110
tinctoria Kellogg 111
Comandra 33
pallida A. DC 33
umbellata (L.) Nutt. 33
Commelina 18
coelestis Willd. 18
pallida Willd. 18
Commelinaceae 18
Conioselinum 87
scopulorum (A. Gray) C. & R. 88
Conopodium 37
Cooperia 29
acuminata Herb. 30
Drummondii Herb. 30
Convolvulaceae 103, 104, 105, 106, 107, 108, 109

Page

Convolvulus 103
arvensis L. 103
atriplicifolius Poir. 103
californicus Choisy 103
luteolus A. Gray 103
repens L. 103
sepium L. 103, 104
spithameus L. 103
subacaulis Buch. 103
Cordia 114
allidora (R. & Pav.) Cham. 115
gerascanthus L. 115
Cornaceae 94, 95
Cornus 94
Canadensis L. 95
Cornutia grandifolia Schauer 119
Corydalis 17
Coulterophytum 92
Holwayi Rose 92
laxum Rob. 92
Crassulaceae 54
Cressa 104
aphyla Heller 104
cretica L. 104
depressa Good. 104
Truxillensis H. B. K. 104
villosa Hoffm. 104
Cruciferae 44, 45, 46, 47
Cryptanthe 115
flaccida (Lehm.) Greene 115
Torreyana (Gray), Greene 115
Cryptotaenia Canadensis DC. 87
Cuphea 71
aquipetala Cav. 72
eyanea DC. 71
Hookeriana Walp. 71
nitidula H. B. K. 71
procumbens Cav. 72
squamuligera Koehne 71
Cymopterus terebinthinus T. & G. 91
Cynomarathrum 90, 94
Eastwoodiae C. & R. 91
Nuttallii (Gray) C. & R. 94
Cypripedium 32
hirsutum Mill. 32
Cyrtoryncha 13
neglecta Greene 14
ranunculina Nutt. 14

Dewya 84, 85
arguta T. & G. 85
Delphinium 8
Dianthus 42
barbatus L. 43
Dichondra 105
repens Forst. 105
sericea Sw. 105
Diorchidium 105
Dodecatheon 97, 98
alpinum Greene 98
cruciatum Greene 97
Hendersonii A. Gray 97
Jeffreyi Moore 98
latifolium (Hook.) Piper 97
Meadia 97
Dolichos 57
Draba 44, 45
arabisans Michx. 45
speciosa Greene 44
Drudeophytum 84
Hartwegi (Gr.) C. & R. 85

Echinopteryx 59
Lappula Juss. 60
Elmera racemosa (Wats.) Ryd. 50
Elymus 114
Epilobium 73, 74, 75
alpinum L. 73, 74
anagallidifolium 74
angustifolium 74
clavatum Trel. 74
hirsutum 75
lanceolatum 75
organifolium 73
paniculatum Nutt. 75
rigidum Hausek. 75
Erigenia 84
bulbosa 83, 84
Eryngium bulbosum 84

Page

Erysimum 44
asperum Arkansanum Gray 44
cheiranthoides L. 44
hieracifolium 44
Eulobus 76, 77
Californicus Nutt. 77
Eupatorium macrophyllum 33
Euphorbia 60, 61
calyculata H. B. K. 57, 61
continifolia L. 61
Eritreae Schweinf. 61
scotana Boiss. 61
Euphorbiaceae 60, 61
Evolvulus 105
pilosus Nutt. 106

Ferula dissoluta Wats. 93
multifida 93
Ficus 33
Fuchsia 79
thymifolia H. B. K. 80

Gayophytum 78, 79
caesium Nutt. 78
diffusum T. & G. 78
intermedia Rydb. 78
lasiosperma Greene 78
racemosum T. & G. 78
ramosissimum T. & G. 78, 79
Gentiana 98, 99
affinis Griseb. 99
Andrewsii Griseb. 99
Bigelowii 99
calycosa Griseb. 99
ciliata 99
Menziesii Griseb. 99
Oregana Engelm. 99
Parryi Engelm. 99
Pneumonathe 99
puberula Mx. 99
sceptrum Griseb. 99
Gentianaceae 98, 99, 100
Geraniaceae 57
Geranium 57
affine 39
Fremontii Torr. 57
incisum Nutt. 57
maculatum L. 39
molle 39
nodosum 39
palustre 39
phaeum 39
pratense 39
pusillum 39
Richardsonii F. & M. 57
rotundifolium 57
sylvaticum 39
venosum Rydb. 57
Gilia 109, 110, 111, 112
atractyloides (Benth.) H. & A. 110
californica (Hook. & Arn.) Benth. 109
capitata Dougl. 110
ciliata Benth. 110, 111
ciliata neglecta (Greene) Brand 111
divaricata Nutt. 110
gilioides (Benth.) Greene 110
gracilis (Dougl.) Hook. 111
gracilis micrantha (Kellogg) Brand 111
liniflora Benth. 110
liniflora phaernaceoides (Benth.) Brand 110
Nuttallii A. Gray 112
pinnatifida Nutt. 110
pungens (Torr.) Benth. 110
Ginseng 81
Glycosoma occidentalis 88
Godetia 76, 77
amoena Don. 77
Bottae Spach. 77
epilobioides (Nutt.) Wats. 77
Gonolobus 101
bifidis Hemsl. 101
erianthus Decne. 101
laevis Mx. 101
suberosus R. Br. 101
uniflorus H. B. K. 101
Gramineae 53
Guilleminea 40
illecebroides H. B. K. 41

Page

Halenia 99
Halenia deflexa Griseb. 99
Halorrhagidaceae 80
Heliotropium 115
indicum L. 116
Hepatica acutiloba 56
Heteropteryx 58, 59
Portillana Wats. 58
Heuchera 47
Americana L. 48
cylindrica Dougl. 47, 50
glabra Willd. 50
glabella T. & G. 48
hispida Pursh 47
micrantha Dougl. 50, 51
ovalifolia Nutt 48
parvifolia Nutt 47
rubescens Torr. 48
Hydrocotyle 81, 82
Hydrophyllaceae 113, 114
Hydrophyllum 113
capitatum Dougl. 114
Virginicum L. 114
Watsoni (A. Gray) Rydb. 114

Impatiens 62
aurea Muhl. 63
biflora Wahl. 63
Noli tangere 63
Ipomoea 103, 106, 109
arborescens (H. & B.) Don. 108
fistulosa Mart. 107, 108
glabriuscula House 106
intrapilosa Rose 107, 108
murucoides, R. & S. 108
pandurata (L.) Meyer 103
purga Hayne 106
Steudelii Millsp. 106
tiliacea (Willd.) Choisy 106
trichocarpa Ell. 106
triloba L. 106
Wolcottiana Rose 109
Iresine 41
Iridaceae 31
Iris 31
Douglasiana Herb. 31
longipetala Herb. 31
versicolor L. 31
Xiphium L. 31
Isnardia 73

Juncaceae 19
Juncoides 19
campestre (L.) Kuntze 19
Jussiaea 72

Lantana 116, 117
Camara L. 117
hispida H. B. K. 117
horrida H. B. K. 117
involucrata L. 117
odorata L. 117
purpurea Jacq. 117
Lappula 116
floribunda Greene 116
Lavatera 66, 67
Leguminosae 57
Leptotaenia 92, 93
dissecta Nutt. 93
multifida Nutt. 93
Ligusticum 87, 88
scopulorum Gray 88
Liliaceae 20, 21, 22, 23, 24, 25, 26, 27, 28, 29
Lippia 117
asperifolia Rich. 118
callicarpaefolia H. B. K. 118
lycioidis 118
myriocephala Schl. & Cham. 118
Pringlei Briq. 118
staechadifolia (L.) H. B. K. 117
strigosa Turcz. 118
umbellata Cav. 118
Lithospermum canescens 106
Lithopragma parviflora (Hook.) Nutt. 51
Loeselia 113
ciliata L. 113
glandulosa (Cav.) G. Don. 113
mexicana (Lam.) Brand 113

Page

Lomatium 93
foeniculaceum (Nutt.) C. & R. 93
orientale C. & R. 93
platycarpum (Torr.) C. & R. 93
Suksdorfii (Wats.) C. & R. 93
triternatum (Pursh) C. & R. 93
Ludwigia 72
polycarpa S. & P. 73
sphaerocarpa 73
Luzula 19
campestris 19
maxima 19
Lysimachia ciliata 98
Lythraceae 71, 72

Malpighiaceae 58, 59, 60
Malva 66, 67
Sherardiana L. 66
Malvaceae 64, 65, 66, 67
Malvastrum 64, 65, 66, 67
coccineum Gray 66
coromandelinum (L.) Garcke 67
splendens Kellogg 66
Thurberi Gray 66
Marsdenia 102
mexicana Decne 103
Mertensia 116
arizonica Greene 116
cynoglossoides Greene 116
oblongifolia Don. 116
polyphylla Greene 116
siberica Don. 116
Metastelma 102
augustifolium Turcz. 102
penicillatum 102
Schlechtendalli Decne 102
Meum 37
Mitella 47
Breweri Gray 50
diphylla L. 50
nuda L. 50, 51
ovalis Greene 50
pentandra Hook. 50
stauropetala Piper 48
trifida Graham 48, 50
Montia 41
asarifolia (Bong.) Howell 42
sibirica (L.) Howell 42
Moraceae 33
Musineum 84, 93
divaricatum (Pursh) C. & R. 93
Hookeri (Torr. & Gray) Nutt. 93
tenuifolium Nutt. 84
Myrcia 59
Myrrhis procumbentis 83

Navarretia intertexta (Benth.) Hook. 110
squarrosa (Eschsch.) Hook. & Arn. 110
Nesaea verticillata 73

Oenothera 76, 77
bistorta 77
densiflora 77
heterantha 78
hirtella Greene 77
micrantha Hornem. 77
spiralis Lehm. 77
strigosa 77
strigulosa Torr. & Gray 77
Onagraceae 72, 73, 74, 75, 76, 77, 78, 79, 80
Orchid 32
Orchidaceae 32
Oreoxis humilis Raf. 84
Osmorrhiza 83
brevistylis 83, 84
occidentale 84
Oxalidaceae 58
Oxalis 58
Oxypolis 87, 88
Fendleri (A. Gray) Heller 88
Oxyria 36
digyna (L.) Camptd. 36

Panax 81
trifolium L. 81
Papaveraceae 17
Parnassia fimbriata Banks 52
Peucedanum simplex 93

Page

Phacelia 114
circinata A. Gray 114
heterophylla Pursh 114
Philibertia 101, 102
crassifolia Hemsl. 102
cyanchoides A. Gray 101
hirtella Vail. 101
linearis A. Gray 101
viridiflora Br. & Rusby 101
Phlox 47, 110, 112
albomarginata Jones 111
canescens Torr. & Gray 111
diapensioides Rydb. 111
divaricata L. 47, 112
Douglasii Hook. 111, 112
Douglasii Hook. diffusa (Benth.) Gray 111
Hoodii Richards 112
longifolia Jones 111, 112
longifolia Nutt. 112
multiflora depressa E. Nelson 111
pilosa L. 112
procumbens Lehm. 111
speciosa Pursh 112
Stanburyi (Torr.) Heller 112
subulata L. 111
Pitcairnia 17
Palmeri Wats. 18
Plum 56
Podophyllum 16
peltatum L. 17
Polemoniaceae 109, 110, 111, 112, 113
Polemonium 112
caeruleum L. 113
occidentale Greene 113
Polygala 60
paucifolia Willd. 60
Polygalaceae 60
Polygonaceae 34, 35, 36, 37, 38, 39, 40
Polygonum 36, 37, 38
amphibium 39
bistortoides Col. 37, 88
bistortoides Pursh 37
Convolvuli L. 39
Convolvulus 39
Davisiae Brewer 37
emersum (Mx.) Britton 39
Hartwrightia Gray 39
hirsutum Walt. 39
hydropiperoides Mx. 39
lapathifolium nodosum Small 39
linearifolium (Wats.) Small 37
Pennsylvanicum L. 39
scandens L. 39, 40
Virginiana L. 39
viviparum 40
Portulacaceae 41, 42
Primulaceae 97, 98
Prionosciadium 92
dissectum C. & R. 92
Nelsoni C. & R. 92
Watsoni C. & R. 92
Proserpinaca 80
palustris L. 80
pectinata Lam. 80
Prunus 56
Besseyi 56
Persica 56
Pseudocymopterus 84, 91
anisatus C. & R. 84, 91
montanus C. & R. 91
Pteryxia 90
calcarea (Jones) C. & R. 91
terebinthina (Hook.) C. & R. 91
Pulsatilla 11, 12
hirsutissima 10, 12
hirsutissima (Pursh) Britton 9

Ranunculaceae 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
Ranunculus 13
alpestris 14
Eschscholtzii Schlecht 14
repens L. 13
Rhamnaceae 63, 64
Rhamnus 53, 63
Alaternus L. 64
crocea Nutt. 64
illicifolia Kellogg 64
Ribes 34, 52, 53, 54
lacustre (Pers.) Poir. 53
petraeum 53
rubrum L. 53, 54

Page

Rosaceae 54, 55, 56
Rubiaceae 43
Rumex 34, 37
Acetosa 36
arifolius All. 35
Brittanica L. 34, 53
hastatulus Baldw. 35
hymenosepalus Wats. 35
Mexicanus Meissn. 35
salicifolius Weinm. 35

Sanicula 82, 87, 93
Santalaceae 33
Sapindaceae 62
Saxifraga 47, 48
bronchialis L. 49
granulata 51
integrifolia Hook. 47
Lyallii Engler 50
Mertensiana Bong. 49, 50
nivalis L. 47
nudicaulis Don. 48
Pennsylvanica L. 47
punctata L. 48, 50, 51
rotundifolia 51
Virginiensis Michx. 47
Saxifragaceae 47, 48, 49, 50, 51, 52, 53, 54
Sedum 54
roseum (L.) Scop. 54
Serjanea 62
racemosa Shuttlew. 62
Sida 64, 65
hederacea (Dougl.) Torr. 65
lepidota A. Gray 65
Sidalcea 66, 67
malvaeflora (Moc. & Sesse) Gray 66
Oregona (Nutt.) Gray 67
spicata Greene 66
Sieversia 54
turbinata (Rydb.) Greene 55
Sisymbrium 44
Linifolium Nutt. 44
Smelowskia 46
Americana Rydb. 46
Smilax 29
Bona-nox L. 29
glauca Walt. 29
hispida Muhl. 29
laurifolia L. 29
rotundifolia L. 29
Sphaeralcea 66
angustifolia Don. 66
Munroana (Dougl.) Spath. 66
Sphaerostigma 77
Spergula 42
arvensis L. 43
Stachytarpheta 118
cayennensis Vahl. 119
Jamaicensis (L.) Vahl. 119
Stellaria 42
borealis Bigel. 43
longipes Goldie 43
longipes Edwardsii Wats. 43
longipes laeta Wats. 43
Steironema 98
ciliatum (L.) Raf. 98
Stigmatophyllon 59
periplocifolium (Desf.) Juss. 59
Stilbum 56
Swertia 100
perennis L. 100
scopulina Greene 100

Taenidia 88
integerrima (L.) Drude 89
Taraxia 77
heterantha (Nutt.) Small 78
ovata (Nutt.) Small 78
Tellima grandiflora R. Brown 50
Thalictrum 11, 12, 40
alpinum 37
dioicum L. 12
polygamum Muhl. 12
purpurascens L. 12
Thlaspi 46
glaucum Nelson 46, 47
Tiarella 51
cordifolia L. 50, 51
laciniata Hook. 50
trifoliata L. 50, 52
unifoliata Hook. 50

Page

Tiliaceae 64
Tolmiea Menziesii T. & G. 50
Trautvetteria 12
grandis Nutt. 13
Triumfetta 64
semitriloba L. 64

Umbelliferae..... 37, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94

Velaea Hartwegi (A.Gr.) C. & R. 85
Veratrum 20
Californicum Durand 21
parviflora Michx. 20
viride Ait. 21
Woodii 20
Verbenaceae 116, 117, 118, 119
Vincetoxicum 101, 102
gonocarpus Walt. 101
mexicanus S. Wats. 102
palustre (Pursh) Gray 101
Viola 67, 70, 71
blanda L. 68
Canadensis 68, 71
canina 70, 71
cognata 71

Page

Viola—*Continued*
glabella 70
Langsdorfii Fisch. 68
lobata Benth. 69
Nuttallii Pursh 69
ocellata Pursh 69
orbiculata Geyer. 69
palustris L. 68
primulaefolia 70
Rydbergii 70, 71
Violaceae 67, 68, 69, 70, 71
Violet 69

Waldsteinia 55
fragarioides (Michx.) Tratt. 55
Witches'-broom 101, 115

Xerophyllum 20
asphodelioides (L.) Nutt. 20

Zauschneria 77
Californica Presl. 77
Zizia 86
cordata (Walt.) Koch. 86
Zygadenus 20
elegans Pursh 20, 21

INDEX TO UREDINEAE

Synonyms are in italics

	Page
Aecidium argentatum Schultz	62
Asparagi Lasch.	27
Bellidis	19
Calthae Grev.	5
Calystegiae Cast.	103
Clarkiae Diet. & Holw.	76
Cressae DC.	104
Dichondrae Har.	105
Dichondrae Neg.	105
dubium Clinton	103
Epilobii DC.	74
Fraserie Trel.	100
fuscum Pers.	9
Gayophyti Vize.	78
Geranii masculati Schw.	38
Galiae Peck	112
Holboellii Hornemann	44, 45
Ipomoeae Speg.	106
Isnardiae Lagerh.	73
Ludwigiae E. & E.	72, 73
Nesaeae Ger.	72
Osmorrhizae Peck	83
Phaceliae Peck	114
Phlogis E. & E.	112
Podophylli Schw.	16
punctatum Pers.	8, 56
sanguinolentum Lindr.	38, 39
Sommerfeltii Johans.	37, 40
Swertiae Opiz.	100
Violae Schum.	70
Violarum DC.	70
Wilcoxianum Thuem.	112
Allodus crassipes Arth.	106
Cryptotaeniae (Pk.) Arth.	87
Douglasii Orton	110
effusa Arth.	69
Giliae Orton	109
Giliae (Peck) Orton	111, 112
insignis Orton	109
Jonesii (Peck) Arth.	93
megalospora Orton	107
melanconioides Arth.	97
Nesaeae Arth.	72
nocticolor Orton	107
opulenta Orton	106
Oregonensis Arth.	92
plumbaria Arthur	111
superflua Orton	108
Swertia Orton	100
Bullaria bullata (Pers.) Wint.	88
Umbelliferarum DC.	88
Caeoma apiculosum Link.	62
Arenariae Lk.	42
Chelidonii Schw.	83
Claytoniatum Schw.	41
Cressatum Lk.	104
Heucherae Link.	50
Hydrocotyles Lk.	81
impatientis Link.	62
Iridis Schw.	31
Podophyllatum Schw.	16
Polygonorum Link.	38
porphrogeneta	55
Saxifragarum Schlecht.	50
Smilacis Link.	29
Smilacis Schw.	29
Thalictri Sommf.	40
verrucosum Nees.	42
Dasyspora Canadensis Arth.	68
Circaeae Arth.	79
Dayi Arth.	98
Epilobii Arth.	73
Fergussoni Arth.	68
Geranii-silvatici Arth.	57
Gonolobi Arth.	101
Haleniae Arth.	99
heterospora Arth.	65
Jaliscensis Arth.	71

Dasyspora—Continued	Page
Lantanae Arth.	117
Malvacearum Arth.	66
Mesnieriana Arth.	63
Pyrolae Arth.	60
scandica Arth.	73
Sherardiana Arth.	66
Dicaeoma arabicola Kuntze	112
Arechavaletae (Speg.) Kuntze	62
argentatum Kuntze	62
asperius (E. & E.) Kuntze	92
Boisduvaliae Kuntze	76
bullatum (Pers.) Kuntze	88
Cicutae (Lasch.) Kuntze	85
Circaeae Kuntze	79
Clarkiae Kuntze	76
crassipes Kuntze	106
Cressae Kuntze	104
Cryptotaeniae (Pk.) Kuntze	87
Cynanchi Kuntze	102
Dayi Kuntze	98
Dichondrae Kuntze	105
Douglasii Kuntze	110
Epilobii Kuntze	73
Euphorbiae Kuntze	61
Fergussoni Kuntze	68
fragile Kuntze	112
Gayophyti Kuntze	78
Gentianiae Kuntze	98
Geranii-silvatici Kuntze	57
giganteum Kuntze	74
Gonolobi Kuntze	101
Haleniae Kuntze	99
heteranthum Kuntze	77
Hydrophylli Kuntze	113
intermedium Kuntze	75
Ipomoeae Kuntze	106
Jonesii (Peck) Kuntze	93
Lantanae Kuntze	117
Ligustici (E. & E.) Kuntze	87
Lithospermi Kuntze	105
lobatum, Kuntze	64
Malvacearum Kuntze	66
Malvastri Kuntze	66
melanconioides Kuntze	97
Mertensiae Kuntze	116
Mesnierianum Kuntze	63
Nesaeae Kuntze	72
obliquum Kuntze	102
opulentum Kuntze	106
Oxalidis (Diet. & Ellis) Kuntze	58
plumbarium Kuntze	111
Polemonii Kuntze	112
Pulsatillae Opiz.	11
Pyrolae (Cke.) Kuntze	60
scandicum Kuntze	73
Sherardianum Kuntze	66
subcollapsum Kuntze	102
Swertiae Kuntze	100
verucosum Mart.	42
Violae Kuntze	70
Erysibe cinnamomea Convolvuli Wallr.	38
cinnamomea Polygonorum Wallr.	38
Lecythea Pruni-spinosae (DC.) Lev.	55
Nephlyctis conjuncta Arth.	118
Prospodium Lippiae Arth.	117
tuberculatum Arth.	116
Puccinia	4, 15
aberrans Peck	46
Acerum Lk.	53
Acetosae (Schum.) Koern.	35, 36
aculeata Link.	16
aculeata Schw.	16
acuminata Peck	94
Adoxae	50
Aegopodii (Schum.) Lk.	88

Puccinia—*Continued* Page

Agrostemmae Fckl. 42
albescens 63
Aletridis B. & C. 28
Allii Cast. 22
Allii Rud. 22
alliorum (DC.) Corda 22, 23, 24
alpina 68
ambiens Rostr. 45
amphispilusa Diet. & Holw. 37
anachoreta Ell. & Hark. 26
Anemones Pers. 9
Anemones-Virginianae Schw. 9, 10
Angelicae E. & E. 90
Angelicae (Schum.) Fckl. 89
Angelicae-Bistortae Kleb. 37
Angelicae-mammillata Klebahn 37
annulata E. & E. 74
arabicola E. & E. 47, 112
Araliae E. & E. 81
Archangelicae Blytt 89
Arechavaletae Speg. 62
Arenariae (Schum.) Wint. 42
areolata Diet. & Holw. 7
argentata (Schultz) Wint. 62, 63
Asari Link 34
asarina Kuntze 34
Asparagi DC. 27
aspera Diet. & Holw. 49
asperior E. & E. 92
Astrantiae B. & C. 87
atropuncta Peck & Clinton 20
aurea Spreng. 16
Bakeriana Arth. 90
Barbareae Cooke 44, 45
Bellidis Lagerh. 19
Berberidis-trifoliae Diet. & Holw. 16
Berkleyana De Toni 105
Bistortae (Str.) DC. 36, 37, 38, 88
Bistortae Mart. 36
bistortoides 88
Blasdalei Diet. & Holw. 22, 23
Blyttiana Lagerh. 13, 14
Blyttii De Toni 54
Boisdevaliae Peck 76, 77
Bomareae P. Henn. 30
Brandegei Peck 17
Buchani De Toni 36
bullata Lk. 53
bullata (Pers.) Wint. 88
Calochorti Peck 26
Calthae Link 5, 6
calthaecola Schroet. 5, 6
Canadensis Arth. 68
Cari-Bistortae Kleb. 37
caudata Barclay 42
Cheiranthi E. & E. 44
Chrysoplenii Grev. 48
cinnamomea Diet. & Holw. 32
Circaeae Fckl. 79
Circaeae Mart. 79
Circaeae Pers. 79
circinans Fckl. 42
Cicutae Lasch. 85
Cicutae Thuem. 85
Cicutae majoris Wint. 85
Clarkiae Peck 76
clavuligera Iridis Wallr. 31
claytoniata (Schw.) Syd. 41
cohaesa Long 8
Comandrae Peck 33
Commelinae Holw. 18
compacta De By. 9
compacta Kuntze 9, 100
concrescens E. & E. 100
congregata Hark. 50
conjuncta Diet. & Holw. 118
Conopodii-Bistortae Kleb. 37
consimilis E. & E. 44, 45
Convolvulii (Pers.) Cast. 103
Cooperiae Long. 29
Cordiae (P. Henn.) Arth. 114
coronata 53
Coulterophyti Diet. & Holw. 92
crassa Lk. 42
crassivertex Thuem. 31
Cressae (DC.) Lagerh. 104
cressipes B. & C. 106
cretica Holw. 104
Crucifearum 47
Cryptanthes Diet. & Holw. 115
Cryptotaeniae Peck 87
Cupheae Holw. 71
curtipes Howe 47
Cymopteri Diet. & Holw. 90
Cynanchi Lagerh. 102

Puccinia—*Continued* Page

Cynoctoni Lev. 102
Cynomarathri 94
Cypripedii Arth. & Holw. 32
Dayi Clinton 98
De Baryana Thuem. 9
Delphinii Diet. & Holw. 8
densa Diet. & Holw. 70
denticulata Otth. 42
Dianthi DC. 42
Dichelostemmae Diet. & Holw. 24, 25
Dichondrae Berk. 105
Dichondrae Mont. 105
diffusa Holw. 13
digitata Ell. & Hark. 63
discoidearum Asparagi Wallr. 27
discolor Fckl. 55
Dolichi Arth. 57
Douglasii Ell. & Everh. 110, 112
Drabae Hazsl. 45
Drabae artica P. Henn. 45
Drabae Rudolphi 45
Echinopteridis Holw. 59
effusa Diet. & Holw. 68, 69, 71
Ellissii De Toni 90, 94
elongata Schroet. 5
Epilobii DC. 73, 74
Epilobii proserpinaceae Farlow 80
Epilobi-Fleischeri Fischer 75
Epilobi-tetragoni (DC.) Wint. 74, 76
Eulobi Diet. & Holw. 76, 77
Euphorbiae P. Henn. 61
Euphorbiae intumescens Syd. 60
Euphorbiae longipes Syd. 61
Euphorbiae minor Diet. & Holw. 61
fasciata Bon. 42
Fergussoni B. & Br. 68
Fergussoni hastatae De T. 70
fragilis Tracy & Hall 112
Fuchsiae Syd. & Holw. 79
Fuckelii Koern. 57
fumosa Holw. 113
fusca (Pers.) Wint. 9, 11, 12
fusca prunastri Wallr. 55
fusca pruni Wallr. 55
Gayophyti Billings 76, 78
Gayophyti Peck 78
Gayophyti Speg. 78
gemella Diet. & Holw. 6
gemella Hedw. 55
Gentianae (Strauss) Lk. 98, 99
Geranii Corda 57
Geranii Lev. 57
Geranii-silvatici Karst. 57
Geranii himalensis Barclay 57
gigantea Karst. 74
gigantispora Bubak. 10
Giliae Harkness 109, 110, 111
giliicola P. Henn. 109
glabella Holw. 76
Gonolobi Rav. 101
granulata De By. 53
granulispora Ell. & Gall. 23, 24
Grossulariae (Gmel.) Wint. 53
grumosa Syd. & Holw. 21
Guillemineae Diet. & Holw. 40
Haleniae Arth. & Holw. 99
hastata Cke. 70
Hazslinskyi De Toni 45
Heliotropii Kern & Kellerm. 115
heterantha E. & E. 77
heterospora B. & C. 65
heterospora *pulcherrima* Lagerh. 65
Heucherae (Schw.) Diet. 48, 50, 51
hirsutissima (Pursh) Britton 11, 12
Holboellii (Hornem.) Rostr. 44, 45
Holwayi Diet. 26
Hydrocotyle (Lk.) Cke. 81
Hydrophylli Peck & Clinton 113, 116
hysteriiformis Peck 43
imperspicua Sydow 85
inflata Arth. 59
inquinans Saxifragae Wallr. 50
insignis Holw. 109
insueta Wint. 60
intermedia Diet. & Holw. 75
intumescens Holw. 57, 60
Ipomoeae Cke. 106
Iridis (DC.) Wallr. 31
Jaliscensis Holw. 71
Jonesii Peck 85, 91, 92, 93
Jussiaeae Speg. 80
Lantanae Farlow 117
lateritia B. & C. 43
Laurentiana Trel. 48
Leveilleana De Toni 57

Puccinia—*Continued* Page

Leveillei Mont. 57
Ligustici E. & E. 87, 88
Lindrothii Sydow 84
Lippiae Speg. 117
Lithophragmae Holw. 51
Lithospermi Ellis & Kellerm. 105
lobata B. & C. 64
Ludwigiae (E. & E.) Holw. 72
luteobasis E. & E. 87, 88
Lychnidiarum Lk. 42
Lychnidis DC. 42
Lysimachiae Karst. 38
macropoda Speg. 41
Malachi Kirchn. 42
Malvacearum Bertero 66
Malvastri Peck 66
mammillata Schroet. 37
Mariae-Wilsoni Clinton 41
Marsdeniae Diet. & Holw. 102
marylandica Lindr. 82
megalospora (Orton) Arth. & Johnst. 107
Mei-mammillata Semadeni 37
melaconioides Ell. & Everh. 97
Melanthii Bubak. 20
Mertensiae Peck 116
Mesnieriana Thuem. 53, 63
mesomegala B. & C. 28
mesomejalis B. & C. 28
microica Ellis 87
mirabilissima Peck 15
modica Holw. 43
Moeringiae Fckl. 42
montanensis 114
Moreniana Dudley & Thompson 24, 25
munita Ludw. 105
Musenii E. & E. 84
mutabilis Ellis & Gall. 22
Myrrhis Schw. 83
Nesaeae E. & E. 72
nidificans Magn. 68
nocticolor Holway 107
nodosa Ell. & Hark. 24
nolitangeris Cda. 62
Nuttallii Ellis & Everh. 13
obliqua B. & C. 43, 102
obscura Schroet. 19
Oenotherae Vize. 76, 77
opulenta Speg. 106
Oregonensis Earle 92, 93
ornata Arth. & Holw. 34, 53
ornatula Holw. 67, 68
Ortoni Jackson 97
Osmorrhizae (Peck) Cke. & Peck 83
Oxalidis Diet. & Ellis 58
Oxypetali P. Henn. 101
oxypus Bon. 27
Oxyriae Buch. 36
Oxyriae Fckl. 36
palefaciens Diet. & Holw. 44, 45
pallido-maculata E. & E. 49
papillata Bon. 50, 62
Parnassiae Arthur 52
Parkerae Diet. & Holw. 34, 52
Persicariae Mart. 38
Phaceliae Syd. & Holw. 114
Philibertiae E. & E. 101
Phragmitis 53
pileata Mayor 74
Pitcairniae Lagerh. 17
plumbaria Peck 47, 110, 111, 112
Podophylli Link. 16
Podophylli Schw. 16
Polemonii Diet. & Holw. 112
Polemonii Störmer 112
Polygalae Fazschke 60
Polygoni A. & S. 38, 39
Polygoni Pers. 38
Polygoni-amphibii Pers. 38, 39
Polygoni-Convolvuli Hedw. 38, 39
Polygoni-Pennsylvanici Schw. 38
Polygoni-vivipari Dietr. 36, 37
Polygoni-vivipari Karst. 36, 37, 88
Polygonorum Duby 36
Polygonorum Fckl. 38
Polygonorum Link. 38
Polygonorum Schl. 38
Polygonorum vivipari Dietr. 36
poromera 90
porphyrogenita Curt. 94
porri 27
Prionsciadii Lindr. 92
Proserpinaceae Farlow 80
Pruni A. & S. 55
Pruni DC. 55
Pruni-spinosae Pers. 55, 56

Puccinia—*Continued* Page

prunorum Fckl. 55
prunorum Lk. 55
Pseudocymopteri 91
pulchella Pk. 53
Pulsatillae Kalchbr. 9, 11, 12
Pulsatillae (Opiz) Rostr. 11
pulverulenta Grev. 74
punctiformis Diet. & Holw. 35
Purpusii P. Henn. 47, 111
Pyrolae Cooke 60
Ranunculi Blytt 13, 14
Ranunculi Seym. 13
retecta Syd. 11
Rhodiolae B. & Br. 54
Rhodiolae Blytt 54
Ribis DC. 53
Ribis papillifera Lagerh. 53, 54
Richardsonii Syd. 110, 111
rotundata Bon. 22
rubricans Holw. 58, 59
rubicunda Holw. 108
Rumicis Lasch. 35
Sagina Kirchn. 42
Saginae Duby 42
Salicum Lk. 55
sanguinolenta P. Henn. 58, 59
Saxifragae Fckl. 50
Saxifragae Schlecht. 50
Saxifragae Schlecht. 51
Saxifragae curtipes Diet. 47
scandica Johans. 73
semireticulata Fckl. 57
septentrionalis Juel. 37, 40
sepulta B. & C. 33
Serjaneae E. & E. 62
Seymourii Lindr. 84
Sherardiana Koern. 66
Sidalceae Holw. 67
Sieversiae Arth. 54
simplex Peck 10
Smilacis Schw. 29
solida Schw. 10
solitaria Syd. 10
Sphaeralceae E. & E. 66
sphaeroidea P. Henn. 72
sphaerospora Syd. & Henn. 102
Sphaerostigmatis Diet. & Neg. 76
sphalerocondra Lindr. 84
Spergula Arenariae serpyllifoliae DC. 42
spreta Peck 50
Stellariae Duby 42
Stellariae Fckl. 42
striata Cke. 47
stromatica B. & C. 12
subangulata Holw. 24, 25
subcollapsa E. & E. 102
suffusca Holw. 11
superflua Holw. 108
Swertiae (Opiz) Wint. 100
Texana Holw. & Long. 15
Thalictri Chev. 11, 12
Thlaspeos Duby 46
Thlaspeos Schubert 46
Thlaspidis Vuill. 46
Thwaitsii Wint. 65
Tiarellae B. & C. 50
Trautvetteriae Syd. & Holw. 12
Traversiana Syd. 90
Treleasiana Pazschke 7
trifoliata E. & R. 51, 83, 84
Triumfettae Diet. & Holw. 64
truncata B. & Br. 31
tuberculata Speg. 116
turrita Arth. 49
uniformis Pammel & Hume 36, 37
Urbaniana P. Henn. 118
Utahensis Garrett 46
Veratri Clinton 21
Veratri Duby 21
Veratri Niessl. 21
verrucosa Bon. 55
verrucosa Schl. 42
Violae (Schum.) DC. 69, 70
Violarum Lk. 70
Vuilleminii De Toni 46
Waldsteinae Curt. 55
Wilcoxianum Thuem. 111
Ziziae E. & E. 86
Zophii Wint. 6
Zygadeni Trelease 20

Page

Trichobasis Epilobii Berk. 75
Hydrocotyle Cke. 81
iridicola Peck 31
Iridis Cooke 31
Polygonorum Berk. 38

Uredo Acetosae Schum. 35
alliorum DC. 22
Alsines Schum. 42
Angelicae Schum. 89
Arenariae Schum. 42
Asparagi Lasch. 27
Betae Convolvuli A. & S. 38
Betae Convolvuli Pers. 103
Bonariensis Speg. 81
bullata Pers. 88
Castagnei Mont. 55
Convolvuli Str. 38
Cordiae P. Henn. 114
Epilobii DC. 74
Gentianae DC. 98
Gentianae Strauss. 98
Heucherae Schw. 50
Hydrocotyles Mont. 81
impatientis Rabh. 62
Iridis DC. 31
Iridis Duby 31
limbata Iridis Rabh. 31
Lippiae Diet. & Holw. 117
Lippiae Speg. 117

Uredo—Continued Page
Lychnidiarum Desm. 42
Polygoni Schum. 38
Polygoni Str. 38
Polygoni Bistortae Str. 36
prunastri DC. 55
Pruni Cast. 55
Pruni Mont. 55
pteridiformis Funk. 36
Smilacis Schw. 29
striolata Speg. 41
tuberculata Speg. 116
vagans a. *Epilobii tetragoni* DC. 74
verrucosa Str. 42
violae Schum. 70

Uromyces Amygdali Cooke 56
Amygdali Pass. 56
Brodiaeae 24
Gentianae Arth. 99
Iridis Lev. 31
Malvacearum Speg. 65
placentula Mont. 55
pulcherrimus B. & C. 65
prunorum Fckl. 55
Sidae Thuem. 65
Thwaitsii B. & Br. 65

Uropyxis 15
mirabilissima (Peck) Magn. 15

Xyloma Allii DC. 22

82321

589 225 H75
HOLWAY E W D NORTH AMERICAN UREDINEAE

INSERT BOOK
MASTER CARD
FACE UP IN
FRONT SLOT
OF S.R. PUNCH

SIGILLVM VNIVERSITATIS ARIZONENSIS
ESTABLISHED 1885

UNIVERSITY OF ARIZO
LIBRARY

MASTER CARD

GLOBE 901144-0

D21